OCTOBER 1955

Power Engineering

How to Pick the Blowdown System You Should Use 61
So—You're Going to Overhaul Your Turbine! VII. Machining Turbine Spindle 65
Repair Hose Damage . . . Save Money 69
Coy Connie's Cold War 70
Use of Limited End-Float Couplings With Centrifugal Pumps 71
How They Control Coal Dust at Joppa 74
This Inhibitor Cuts Corrosion in Heating System 77
Erection, Maintenance Easy on New 330 kv Breakers 78
What Makes an Ultrasonic Machine Tool Work? 80
River on the Rampage—Union Electric's Precautions to Prevent Flood Damage 82
Detroit Edison-Ontario Hydro Interconnection 82
JETS and the Engineer Shortage 83 POWER ENGINEERING News Reel 84
Pneumatic Wood Handling Cuts Fuel Costs by 60% 86
Figure Pipe Sizes the Simple Way 88
Your Boiler Can Enjoy Water 90 Hot Line Tools 90
Algoma's New Automatic Boilers Turn Themselves On or Off 91
Performance Data for Sprayed-on Foaming Plastic Insulation 92
Double-Density Concrete 93 Powerama 94 Water Level On Spot 105

REGULAR DEPARTMENTS

Engineer's Preview 3
Letters to the Editor 4
Here's What They Tell Us 6
Helpful Bulletins 25
Equipment News 42
POWER ENGINEERING Handbook 96
Catalog Library 117
Readers' Service Post Cards 117
Advertisers' Index 132
Circulation of This Issue 36,250

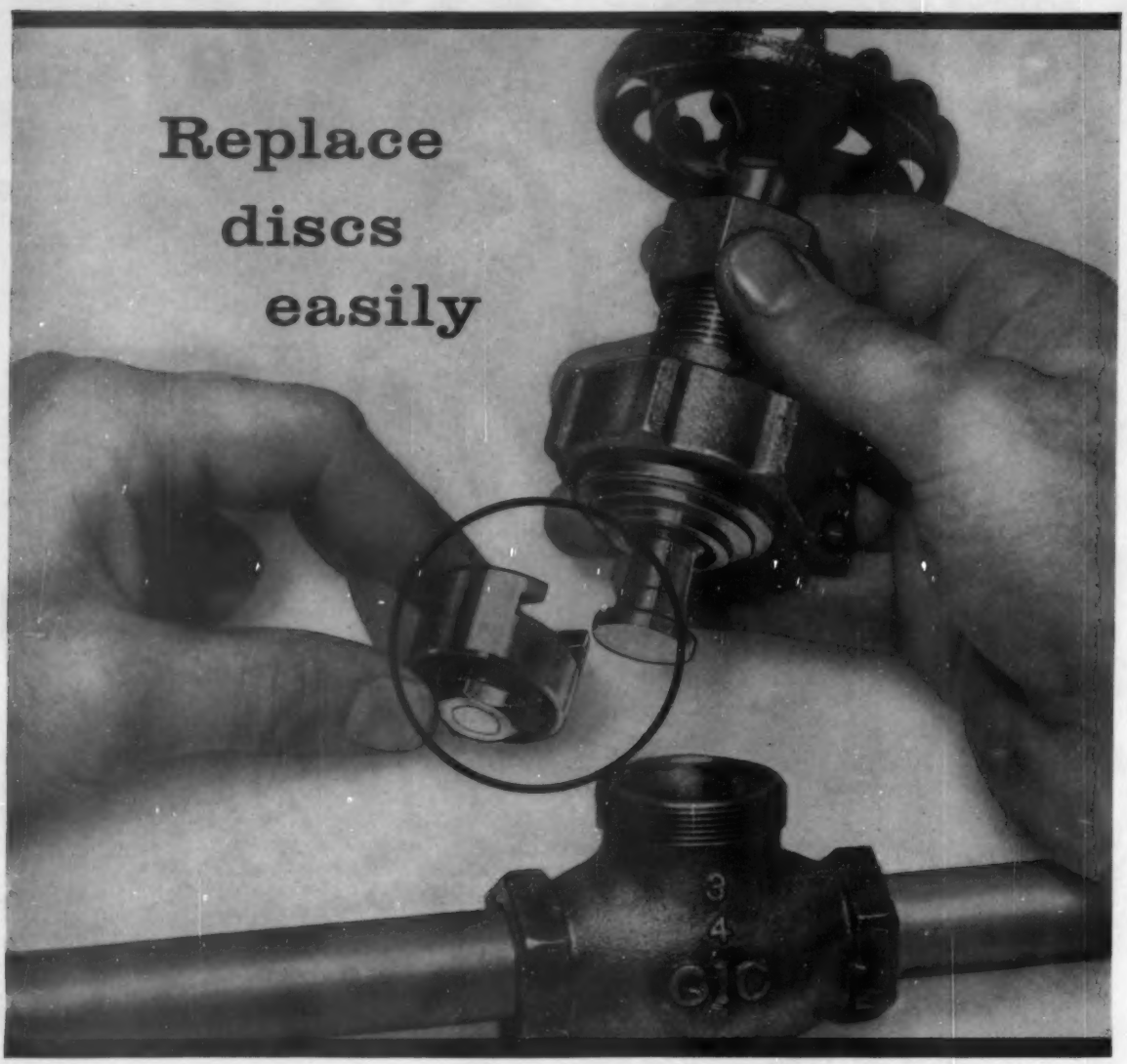


Fig. No. 520, 200 lbs. WSP, @400°F. 400 lbs. cold WOG, non-shock

It takes two minutes or less! Simply break the union joint and slip a replacement disc holder onto the button-head of the stem. Or, replace the disc only.

Additional features of this OIC line greatly reduce the need for other maintenance. For example: (1) The modern union body-bonnet joint assures a safe, tight, leakproof seal which is not affected by frequent dismantlings. (2) The special OIC *alloy-40* stem material eliminates galling and seizing. (3) Molded, graphite-asbestos, plastic packing is used which seals without hardening or cracking in service.

Reduce your valve problems by installing this OIC line wherever you need bronze globe and angle valves with composition discs. Call your OIC Distributor for more facts, or write for Form No. 1001 which describes the entire OIC 500 line with composition discs, as well as spherical and plug-type discs in globes, angles and checks.

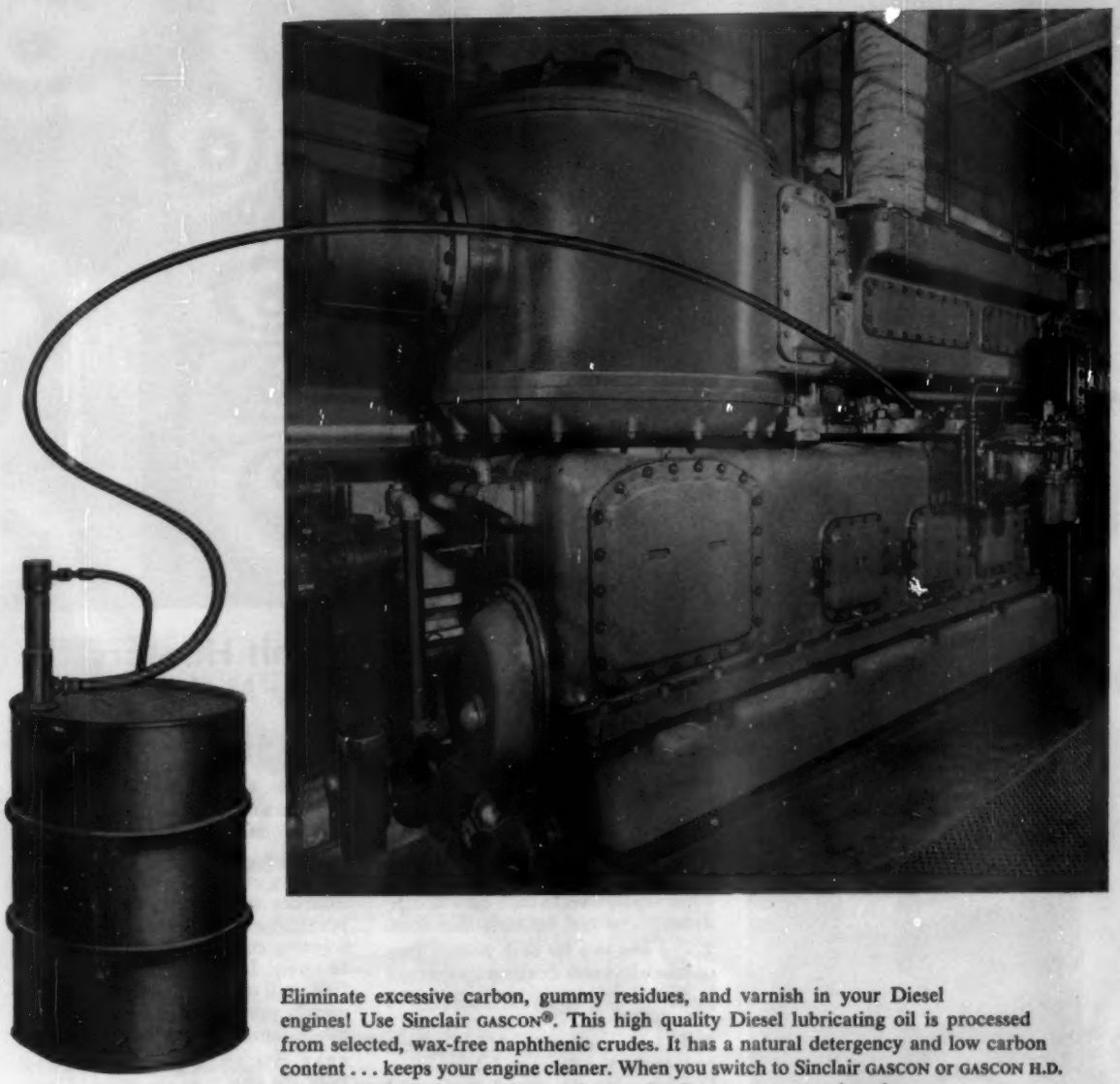
OIC
FOUNDED 1883

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

VALVES | **FORGED & CAST STEEL, BRONZE & IRON, LUBRICATED PLUG VALVES**

For more data circle 501 on Post Card

Check Carbon!

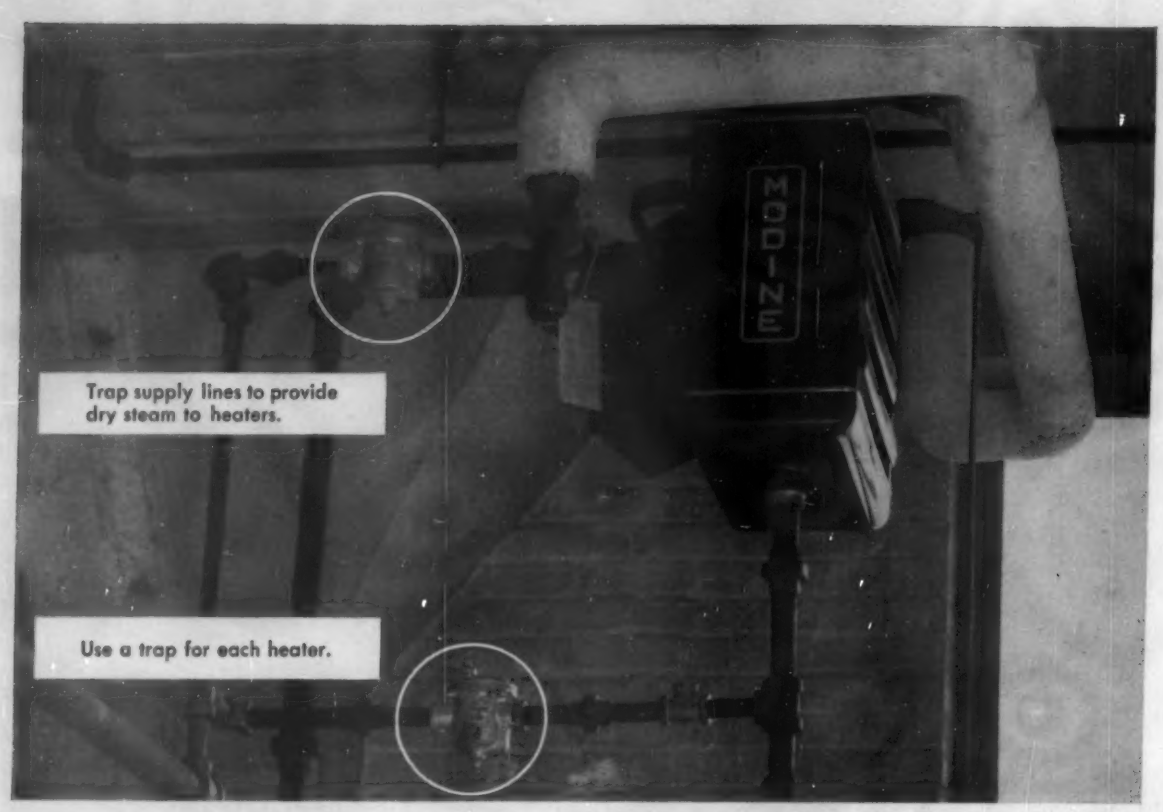


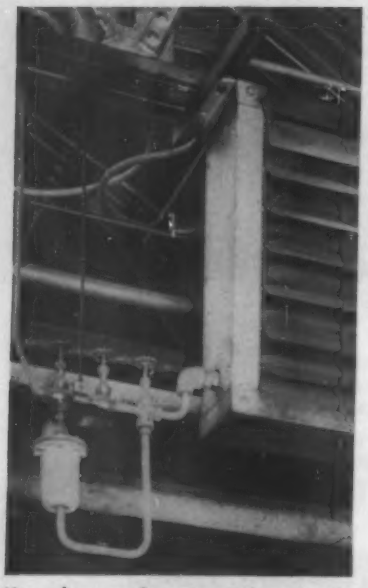
Eliminate excessive carbon, gummy residues, and varnish in your Diesel engines! Use Sinclair GASCON®. This high quality Diesel lubricating oil is processed from selected, wax-free naphthenic crudes. It has a natural detergency and low carbon content . . . keeps your engine cleaner. When you switch to Sinclair GASCON or GASCON H.D. you know that pistons, rings, valves and exhaust ports stay free from carbon, gums and varnish.

No matter what design of engine you're operating, you'll be 'way ahead with Sinclair's complete line of Diesel lubricants. Contact your local Sinclair Representative now for full details, or write Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N.Y.

SINCLAIR GASCON OILS

For more data circle 502 on Post Card





Use a bypass above trap where heater must be kept in operation at all times. Note neat hookup possible with Armstrong vertical connection trap.

Tips on Trapping Unit Heaters for Full Output and Low Maintenance

• If unit heaters are clean and the steam supply and return lines are adequate, their performance will depend entirely upon the steam trapping. Here are some trapping pointers to insure plenty of heat when it is needed:

1. Trap supply lines to take care of condensate formed by radiation loss.

2. Use one trap for each heater. Two or more heaters drained by a single trap will fail to deliver maximum btu output.

3. Size traps properly. Many a unit heater is handicapped by a trap lacking adequate condensate and *air* handling capacity. The few dollars extra for larger traps insure fast heatup, full output and freedom from coil corrosion.

4. Install traps correctly. Put trap below and close to heater. Install a bypass around the trap if the heater must be kept in operation at all times. A shut-off valve in the discharge line facilitates trap inspection. Use of check valves and strainers is dependent upon piping conditions and the traps used.

5. Protect against PRV failure where freezing could occur. Sometimes heaters supplied with reduced pressure steam are installed where freezing could occur if traps failed to open. In this case select traps that will open at maximum steam supply pressure and still have adequate capacity at reduced pressure.

FREE ON REQUEST—COMPLETE INFORMATION on the above points, diagrams, selection data, tables and additional recommendations are contained in Armstrong Bulletin No. 2312. Also includes BTU output ratings for all models of 30 makes of unit heaters. Call your local Armstrong Factory Representative or write:

ARMSTRONG MACHINE WORKS
810 Maple Street • Three Rivers, Michigan

STEAM TRAPS FOR EVERY REQUIREMENT — APPLICATION ENGINEERED

ARMSTRONG STEAM TRAPS

For more data circle 503 on Post Card

ENGINEERS' PREVIEW

TECHNICAL PROGRAM has just been announced for the 1955 AIME-ASME Joint Solid Fuels Conference, to be held at the Neil House in Columbus, Ohio on October 19–21. Keynote of this national conference will be the Future of Solid Fuels, which has bright ned with the remarkable rise of coal production this year after seven years of declining markets. Program includes:

Coal Reserves of the U. S. for Future Use, by Clayton G. Ball, president, Paul Weir Co., Chicago.

Opportunities for the Fuel Technologist in the Coal Industry, by T. S. Spicer, professor, Fuel Technology, Pennsylvania State University, University Park, Penna.

Future Trends in Stoker Design, by Earle C. Miller, research engineer, Riley Stoker Corp., Worcester, Mass.

Trends in Coal Handling for Electric Power Stations, illustrated with the motion picture From Mine to Plant, by Howard E. Nelson, manager, Conveyor Engineering, The Jeffrey Mfg. Co., Columbus, Ohio.

Lignite as a Future Fuel for Steam Generation, by R. L. Sutherland, research consultant, Truax-Traer Coal Co., Chicago, Illinois.

Future of Synthetic Liquid and Gaseous Fuels, by H. R. Batchelder, consulting chemical engineer, and Harlan W. Nelson, chief, Fuels Technology Division, Battelle Memorial Institute, Columbus, Ohio.

Effect of Fly Ash Utilization on the Future of Solid Fuels, by H. H. Russell, project engineer, Bituminous Coal Research, Inc., Pittsburgh.

Full information on program and arrangements available from A. B. Clymer, publicity chairman, Joint Solid Fuels Conference, 1672 Barrington Road, Columbus 21, Ohio.

• • •

SCIENTISTS at the Westinghouse Research Laboratories are purifying titanium and other hard-to-get metals by imprisoning the molten metal inside a cage of its own making. The process, called cage zone refining, uses a unique method to melt a bar of metal while the metal acts as its own crucible, thus preventing contamination by any containing vessel. Object of the process is to prepare super-pure metals. The new technique was developed by P. H. Brace, consulting metallurgist; Dr. A. W. Cochardt of the metallurgy department; and Dr. George Comenetz, advisory Engineer to the metallurgical consulting staff of the Laboratories.

• • •

TWO NEW boiler feed pump installations serving two 225-mw units will be supplied Public Service Electric and Gas Co.'s Linden, New Jersey plant. This will be the first commercial installation in a major utility of a complete set of boiler feed pumps to operate at rotative speeds in the range of 8300 rpm.

All major pumping equipment for the two new generating units will be supplied by Worthington Corporation and will include seven boiler feed pumps each operating at 8300 rpm, seven step-up gears driven by 4500-hp motors and operating from 1780 to 8300 rpm, four 5-stage vertical condensate and booster pumps, four single-stage boiler feed booster pumps, three 2-stage vertical booster pumps, and three 3-stage vertical condensate pumps. Duplicate boiler feed pumps and drivers are applied on two widely different feed systems.

Unit No. 1 has Worthington deaerators ahead of the boiler feed pumps, which are equipped with low speed booster pumps to provide the

EDITORIAL AND BUSINESS STAFF

POWER ENGINEERING IS PUBLISHED MONTHLY • 110 S. DEARBORN ST., CHICAGO 3, ILL. DEARBORN 2-5446

EDITORIAL AND ART STAFF

Editorial Director — Richard H. Morris
Editor — Andrew W. Kramer
Executive Editor — Chester R. Earle
Associate Editor — Norman S. Jones
Associate Editor — Robert J. Mitchell
Associate Editor — R. C. Hagenmiller
Equipment Editor — Marion E. Hendken
Assistant Editor — Irene M. Glen
Editorial Assistant — Mildred Novosel
Staff Artist — James E. Wilcox
Chief Draftsman — Robert W. Koster

OFFICERS AND BUSINESS STAFF

President — Kingsley L. Rice
Executive Vice President — Edwin C. Prouty
Vice President — Walter Painter
Treasurer — Arthur L. Rice, Jr.
Assistant Treasurer — Thomas Walsh
Secretary — Edwin C. Prouty, Jr.
Production Director — John O. Aarvold
Production Manager — Earl R. Noren

Technical Publishing Company is incorporated under the laws of the State of Illinois. Board of Directors: Kingsley L. Rice; Arthur L. Rice, Jr.; Andrew W. Kramer; Edwin C. Prouty; Richard H. Morris.

DISTRICT MANAGERS

New England — Charles R. Lippold, 258 Park Square Bldg., Boston 16, Mass. HA 6-4639; 5 Spring St., Riverside, Conn. NEptune 7-2210
New York 17, N. Y. — Joseph Halloran, 1613 Graybar Bldg. MUrray Hill 5-3779
Philadelphia, Pa. — Oscar Wilde, 1235 Jericho Road (Abington, Pa.) TUrner 6-5968
Pittsburgh 19, Pa. — James S. Tafel, 404 Frick Bldg. COurt 1-4878
Cleveland, Ohio (Euclid 23) — F. Allen Schmidt, 451 Clearview Drive, Suite D REdwood 2-7734
Chicago 3, Ill. — Warren F. Saas, 110 S. Dearborn St. DEarborn 2-5446

McDonald-Thompson offices: Seattle 4, Wash., Harry Abney, 1008 Western Ave., Elliott 3767; San Francisco 5, Cal., Les Meek, 615 Market St., YUkon 6-0647; Los Angeles 5, Cal., Connie J. Grabb, 3727 West Sixth Street, DUnkirk 7-5391; Denver 2, Colo., Robert Heidersbach, 222 Colorado National Bank Building, Keystone 4-4669; Houston 6, Texas, Frank Vickery, Room 214, 3214 Montrose Blvd., LYnchburg 6711; Dallas 6, Texas, Ed J. Whetzle, 5526 Dyer St., FOrest 8-5310.

Subscription Information: Published monthly; price in the United States and its possessions $10, in Canada $11, in other countries $12 per year; single copies $1.00.

Indexed in the Industrial Arts Index and the Engineering Index on file in public and many private libraries.

Micro film edition: Request prices, from University Microfilms, Inc. Ann Arbor, Mich. All volumes since 1948.

Copyright 1955 by Technical Publishing Co., Chicago, Illinois. Accepted as controlled circulation publication at Concord, New Hampshire.

Change of Address: Send to POWER ENGINEERING, Circulation Division, Barrington, Illinois. Please supply your position title, company name, company address. Your request must reach us by the 15th of the month to make the necessary change effective with the following month's issue.

PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL PLANTS

required NPSH. Maximum design flow to the boilers is 3,150,000 lb per hr and the boilers can provide steam to the adjacent Esso Refinery through reducing valves or by extraction from the turbine.

Unit No. 2 has a completely closed feedwater heating cycle, eliminating the deaerators. The maximum design flow is 2,000,000 lb per hr. Operating pressures are 2550 and 2700 psi respectively and the pumps are driven by 1800 rpm motors through hydraulic couplings and step-up gears.

• • •

GENERAL ELECTRIC CO. will manufacture two 16,000-kw combustion gas turbine-generator sets for Planta Electrica of Groupo Industrial in Monterrey, Mexico. The two simple-cycle, single-shaft sets will be installed adjacent to the Hojalata y Lamina steel mill. Natural gas will be used as fuel.

It is expected that eventually the heat in the exhaust gas of the turbines will be used to generate process steam in heat recovery boilers.

• • •

C. HAROLD BERRY, Gordon McKay Professor of Mechanical Engineering at Harvard University and a leader in the field of heat engineering, retired this summer. Prior to joining the Harvard faculty in 1928, Prof. Berry had served as assistant to the chief engineer of The Detroit Edison Co., and as associate editor of *Power* magazine.

For 25 years (1920–1945) he was a member of the Power Test Codes Committee of ASME and chairman of the Individual Committee on Test Codes for Steam Turbines. Recently appointed to a committee advisory to Director of National Bureau of Standards.

Professor Berry has been a frequent contributor to POWER ENGINEERING and other technical publications and is the author of a small book, Flow and Fan (1954) dealing with ventilating systems.

He is a Fellow of ASME and of the American Academy of Arts and Sciences, a member of the NSPE, the engineering honor fraternity Tau Beta Pi, the Society of the Sigma Xi, the Harvard Club of Boston and the Harvard Musical Association. He is a past chairman of the Detroit and Boston sections of the ASME and served as secretary-treasurer of the Metropolitan Section in New York.

LETTERS TO THE EDITORS

Effect of Mixing Coals

Editor's Note: The following data form valuable addition to the information published in our May 1955 issue, pages 98–100.

To the Editor:

TABLE II of Reiter's article on the Ash Fusion Characteristics of Coal (May, 1955, issue), indicates that mixtures of coals produce an ash eutectic of lower fusion temperature properties than those of any of the individual ashes of the separate coals. The results were based upon actual clinker formations in an underfeed stoker. In order to check these findings in our laboratory, where we analyze coals from many different seams for our power generating pulverized firing boilers, the ashes from these coals were utilized in various mixtures and fused in order to see if eutectic mixtures resulted.

The coals used were procured for the stations mostly in the ⅜-in. minus (⅜- or ¼-in. x 0) carbon size. This size is mentioned because the ash fusion temperature properties of a coal may vary among its various sizes. Generally the carbon sizes, the fines, have lower fusion temperature ash than the larger "cleaner" sizes. The coals tried are coded as shown in the accompanying table.

These coals were first separately burned to ash in open dishes, from coal ground to 60 mesh. Then the ashes of each individual coal burned were ground to 200 mesh and cones made up of each one and fired in the ash fusion electric furnace that was supplied with a reducing atmosphere from an external source. The ID, SP and FP were determined by sighting through the door port. Then the ashes of the coals listed below were intimately mixed and standard test cones made up from these different mixes, and these cones heated slowly, the temperature rising 50 deg. F per 5 minutes after a temperature of about 1800 F was passed, up to the point of the disappearance of the cones as liquid absorbed into the ceramic base holding the cones. There was plenty of time for secondary ceramic reactions to take place.

The fusion characteristics of the mixtures showed up as follows:

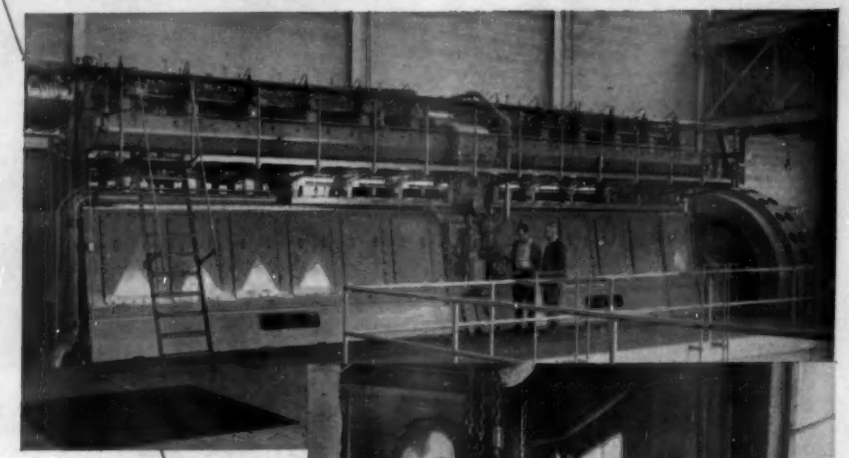
Mix No.	Coal No.	Percentage in mixture	I.D.	S.P.	F.P.
1.	A	50	2420	2470	2570
	B	50			
2.	C	50	2340	2430	2500
	D	50			
3.	E	50	2540	2580	2640
	F	50			
4.	G	50	2320	2370	2400
	H	50			
5.	I	33⅓	2520	2580	2640
	J	33⅓			
	G	33⅓			
6.	K	50	2370	2420	2450
	L	50			
7.	K	50	2420	2470	2520
	N	50			
8.	K	33⅓	2470	2500	2570
	L	33⅓			
	M	33⅓			

During the fusion no contact was made with any additional metallic oxides to reduce the liquid or freezing temperatures so as to permit attack on any parts of a stoker. It was not proposed that these few laboratory tests would simulate actual firing conditions, but rather would indicate to ourselves whether eutectics are produced within laboratory ash cones, wherein the fusion temperatures might be reduced below those of either or all of the coals whose ashes comprise the test mixtures. Widely different types of coal were mixed.

The colors of the cones and mixtures were noted as a laboratory check on the colors of the stoker cinders described in the article. The color of the *continued on page 110*

Coal No.	Seam	State	Normal ash-fusion temperatures, F. Initial Deform.	Soft. Pt.	Liq. Pt.
A	Elkhorn #3	East. Ky.	2400	2450	2500
B	Redstone	No. W. Va.	2470	2520	2620
C	Harlan	East. Ky.	2260	2320	2400
D	Cedargrove	So. W. Va.	2510	2540	2620
E	Hazard #4	East. Ky.	2670	2710	2750
F	Wallins	East. Ky.	2450	2500	2600
G	Elkhorn #3	East. Ky.	2350	2360	2400
H	Leatherwood	East. Ky.	2500	2570	2620
I	Hazard #7	East. Ky.	2730	2770	2800+
J	Hazard #4	East. Ky.	2710	2740	2770
K	Hocking #6	Ohio	2390	2420	2450
L	Elkhorn #3	East. Ky.	2280	2340	2440
M	#5 Block	So. W. Va.	2780	2800+	2800+
N	Cedargrove	So. W. Va.	2490	2545	2590

DE LAVAL "NOZZLE-MATIC" SAVES $3,600 IN ONE MONTH!



When Decatur Public Utilities installed a De Laval AC-VO "Nozzle-Matic"* to purify heavy fuel for their 5380 HP Baldwin diesel, things really happened . . .

As Superintendent L. C. Pettibone reports it: The De Laval "Nozzle-Matic" not only completely purified poor grade No. 5 fuel, but made it possible to burn still cheaper No. 6! Savings over burning regular diesel fuel amounted to approximately $3,600.00 in one month of part-time operation. In over 3800 hours of operation no unusual ring or liner wear has been experienced.

Once again De Laval demonstrates that "If you can pump it, we can purify it." Get all the money-making facts . . . *today*.

*Trademark

DE LAVAL
heavy oil purifiers

THE DE LAVAL SEPARATOR COMPANY Poughkeepsie, New York • 427 Randolph St., Chicago 6 • DE LAVAL PACIFIC CO. 201 E. Millbrae Ave., Millbrae, Calif.

For more data circle 504 on Post Card

HERE'S WHAT THEY TELL US

TYPICAL of the wide interest in Reiter's articles and their usefulness in coal procurement, Plant Engineer C. A. Stang, Baldwin-Lima-Hamilton Corp. said

> I read with great interest your article in the August '55 issue of POWER ENGINEERING, How Dayton P & L Makes Sure It Gets the Right Coal From New Sources. I should like very much to have a copy of your coal source questionnaire and evaluation form so that we might consider setting up a similar reference file.
>
> In the past there has been a duplication of effort on the part of our purchasing agent and the power engineering department, in interviewing coal salesmen and obtaining accurate information relative to specifications of coal. With such a questionnaire, a quicker and certainly a better analysis could be made with less time and effort involved.

E. H. KRIEG, Stone & Webster Engineering Corp, who has just been transferred from the Boston office of S&W to the New York office, wrote

> Thank you for your suggestion about having POWER ENGINEERING addressed here to the office — I believe I have taken care of that because I wanted to be sure that I would not miss a single copy.

C. STEFANETTI, Stauffer Chemical Company, requested the name of the firm making voltage drop charts. The name is Marco-Liberty, Inc., 126 Liberty St., New York 6, N. Y. This company has several charts for various conditions all bound together, and the latest information we had was that the booklet containing these charts cost $2.00 per copy.

ANOTHER READER asking for an opinion on how often to alternate water-tube boilers said

> Some advise a three-month change-over, while others, including some insurance companies, claim that six-month period change-overs are better. They contend that by opening more often, the air does more damage than by six-month periods of alternating . . . (water-tube, bent-tube boiler, three-drum CP type, rating 90 hp, oil burners, used for laundry and sterilizing purposes). Since we have an alternate, we can shift any time, for one boiler will carry the load.

We favored the advice of the insurance companies who insure this type of boiler. We also pointed up the cost factor in opening up a boiler every three months instead of six.

SUPERINTENDENT H. F. WINSLOW, Otter Tail Power Company, wrote

> Our operating personnel are very appreciative of your POWER ENGINEERING Handbook.
>
> In the July '55 issue, the article by R. R. Taggs regarding flue gas CO_2 and excess air, presented a problem in that we have lignite burning units. The average Btu of this fuel is 6500 Btu.
>
> A CO_2 excess air chart for the above would be greatly appreciated.

Associate Editor Bob Mitchell forwarded a carbon dioxide-excess air chart for lignite, constructed of data from Dr. V. F. Parry, Chief of the Bureau of Coal Technology, Bureau of Mines, Denver, Colo.

He also sent the same chart, which includes a presentation for natural gas, to Visking Corporation's Power Engineer L. A. Cookson who commented

> In order for us to obtain the benefit of this article and the charts, we would need a chart showing the relationship of the CO_2 and excess air for natural gas fuel.
>
> We would appreciate having this to add to the article so that we may use it in our training program.

Apparently an interchange of experiences at the instruction level could be of considerable value to readers of the Handbook Section. If *you* have any ideas along these lines write Bob Mitchell.

TO F. V. STANFEL, Oak Ridge, Tenn., Editorial Director Richard Morris noted

> Thank you very much for your courtesy in telling us that you enjoy and use POWER ENGINEERING. Nothing pleases an editor more than to know that he is serving the readers well; and the greatest source of pleasure we have in our work is to have a reader mention this spontaneously as you did.

FOR OVER A YEAR the Philadelphia Section of the American Institute of Electrical Engineers has sponsored the weekly radio program *Meet the Engineer*. It is broadcast from Station WFLN at 7:45 p.m. every Wednesday. Speakers on these programs have been such men as Philip D. Reed, chairman of the board of General Electric Co.; David Sarnoff, chairman of the board, RCA; H. A. Roy Binney, Director British Standards Institution; J. R. Carlson, Engineering Manager, Steam Division, Westinghouse Electric Corp.

Last winter, our Editor Andy Kramer made two of these broadcasts, one on Radioactivity in the Biological Field, and the other on Reasons for Developing Atomic Power Plants. Now, Editor Kramer has again been asked to participate in this program and he has agreed to give two talks. The first, on the evening of October 5, will deal with the development of thermonuclear power. The second will also concern some phase of atomic power.

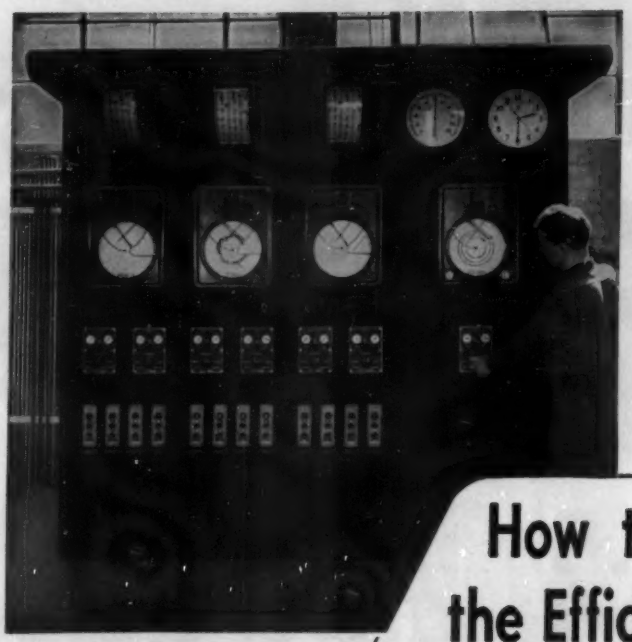
PLANT ENGINEER FLYKE, E. J. Brach & Sons, Chicago candy manufacturer, phoned our office Aug. 8 for information on vacuum deaerators.

Executive Editor Earle, smiling broadly and with a twinkle in his eye, said

> Anticipating his needs for this information, I had already arranged for an article on vacuum degasification which, at that particular moment was going to press in the August issue. (Vacuum Degasification Shows Its Versatility.)

Anyway, when an engineer asks a question like that, it's always a pleasure for an editor to be able to tell him that we are publishing an article on it just at the time when he needs it. Mr. Flyke said he was interested in the subject because he did not have any spare steam for a standard deaerating heater, which requires steam. The vacuum deaerator, on the other hand, can use a mechanically-driven vacuum pump and deaerate the water at low temperatures.

"He doesn't put much store in temperature gages."



These Bailey Boiler Controls at the Chicago Pneumatic Tool Company's new plant in Utica, N. Y. insure efficient operation of three 25,000 lb per hour, 100 psi, spreader stoker-fired boilers

How to INCREASE the Efficiency of YOUR BOILER-ROOM DOLLAR

Before you get steam you've got to spend dollars—so dollars are a form of energy.

And if your boiler-room dollars are invested in equipment that isn't working efficiently, economically, your "investment" is poor.

That's where co-ordinated controls by Bailey can help. Here's why they'll increase your "boiler-room investment efficiency":

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service — conveniently located near you.** Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

For better "boiler-room investment" efficiency —for more power per fuel dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-111-0

BAILEY METERS

BAILEY METER COMPANY

1040 IVANHOE ROAD
CLEVELAND 10, OHIO

Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS

For more data circle 505 on Post Card

"this is

● Engineers tell us Yarway Remote Liquid Level Indicators are the most dependable boiler insurance they can have.

Instant . . . accurate . . . brilliant . . . continuous readings of boiler water level are seen on the panel or wherever you wish in your plant. You know the readings are right because they are controlled by the boiler water itself . . . by the pressure differential between a constant head of water and the varying head in the boiler drum. *Indicating mechanism is never under pressure.*

Yarway Indicators may be equipped with a Yarway Control Unit that operates Remote Hi-Lo-Alarm signal lights or horns. For a 24-hour record of boiler water levels, use the Yarway Hi-Lo-Graph Recorder.

On the boiler drum itself you'll want Yarway Water Gages . . . and these "bright as a star" gage readings can now be televised with a Yarway—RCA Television chain.

From drum to panel and at all remote locations, Yarway equipment gives you the safest boiler protection you can buy . . . proved beyond doubt in thousands of power plants.

Write for the specific bulletins you want.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

NEW! WIDER VISION!

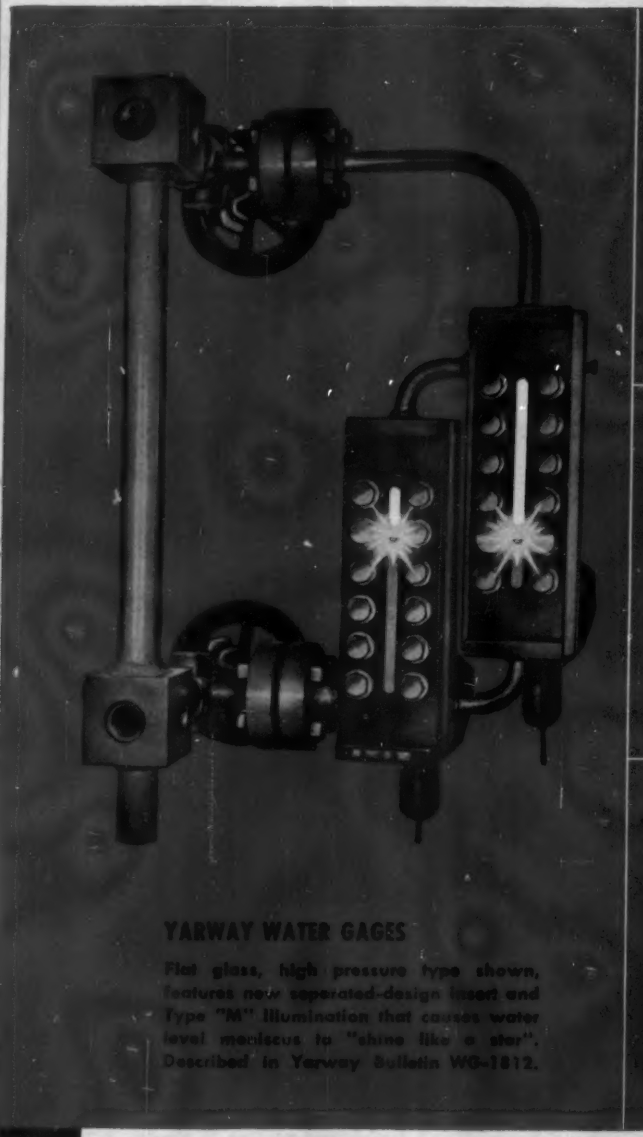
Clear, brilliant readings from any angle, are possible with the new "wide vision" face on the Yarway Remote Liquid Level Indicator. Pointer is always visible, even at extreme high and low water levels.

The Yarway Indicator is manometric type with automatic temperature compensation, as approved for use under the ruling of A.S.M.E. Boiler Code Committee in Case #1155.

Described in Yarway Bulletin WG-1824.

YARWAY

good boiler insurance!"



YARWAY WATER GAGES

Flat glass, high pressure type shown, features new seperated-design insert and Type "M" illumination that causes water level meniscus to "shine like a star". Described in Yarway Bulletin WG-1812.

YARWAY REMOTE SIGNAL ALARMS

Lights and horns, operated by Control [illegible] on Yarway Indicator, give instant warning of any serious deviation from normal water level. Can be located anywhere in plant. Described in Yarway Bulletin WG-1824.

YARWAY HI-LO-GRAPH RECORDER

Gives a continuous 24-hour record of liquid levels. Actuating mechanism is same as in Yarway Indicator. Used both for indicating and recording. Described in Yarway Bulletin WG-1830.

YARWAY RCA TELEVISION

Simplified system consists of compact camera and panel-mounted monitor. Clear, bright image of water level gage anywhere in the plant.
Described in Yarway Bulletin WG-1813.

steam plant equipment

BLOW-OFF VALVES
WATER COLUMNS AND GAGES
LIQUID LEVEL INDICATORS
EXPANSION JOINTS
STEAM TRAPS
STRAINERS
SPRAY NOZZLES
DIGESTER VALVES

For more data circle 506 on Post Card

Mid-Western Utility now

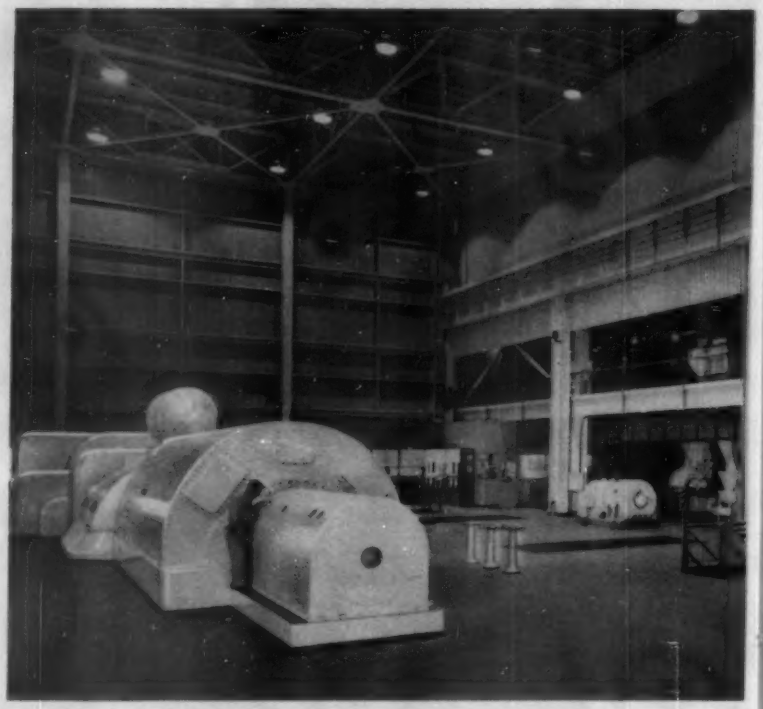
SIXTH FW

New 853,000 lb/hr reheat unit will bring total FW steam generating capacity on this one system to **4,338,000 POUNDS PER HOUR!**

The Foster Wheeler reheat steam generator shown in cross section at the right will serve 100,000-kw Unit No. 2 at a fast-growing steam plant of a large Mid-Western utility. Rated at 853,000 lb per hour, 1800 psi, with 1000/1000 F reheat, it is scheduled to go on line early next year. Work on this plant expansion was already under way when Unit No. 1 went on line in November 1954 — served by an FW 925,000 lb/hr, 1770 psi, 1000F steam generator.

When Unit No. 2 is completed, a total of six FW steam generators, six FW surface condensers and twenty-two FW ball-mill pulverizers will be in service at the various stations of this one Utility.

Repeat orders like this are a positive expression of *confidence* in Foster Wheeler steam plant equipment — confidence that stems from previous *experience*. In major equipment of this type, customer acceptance means satisfaction with the entire job—from planning all the way through to actual operation. Whatever your requirements, it will pay you to consult *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*



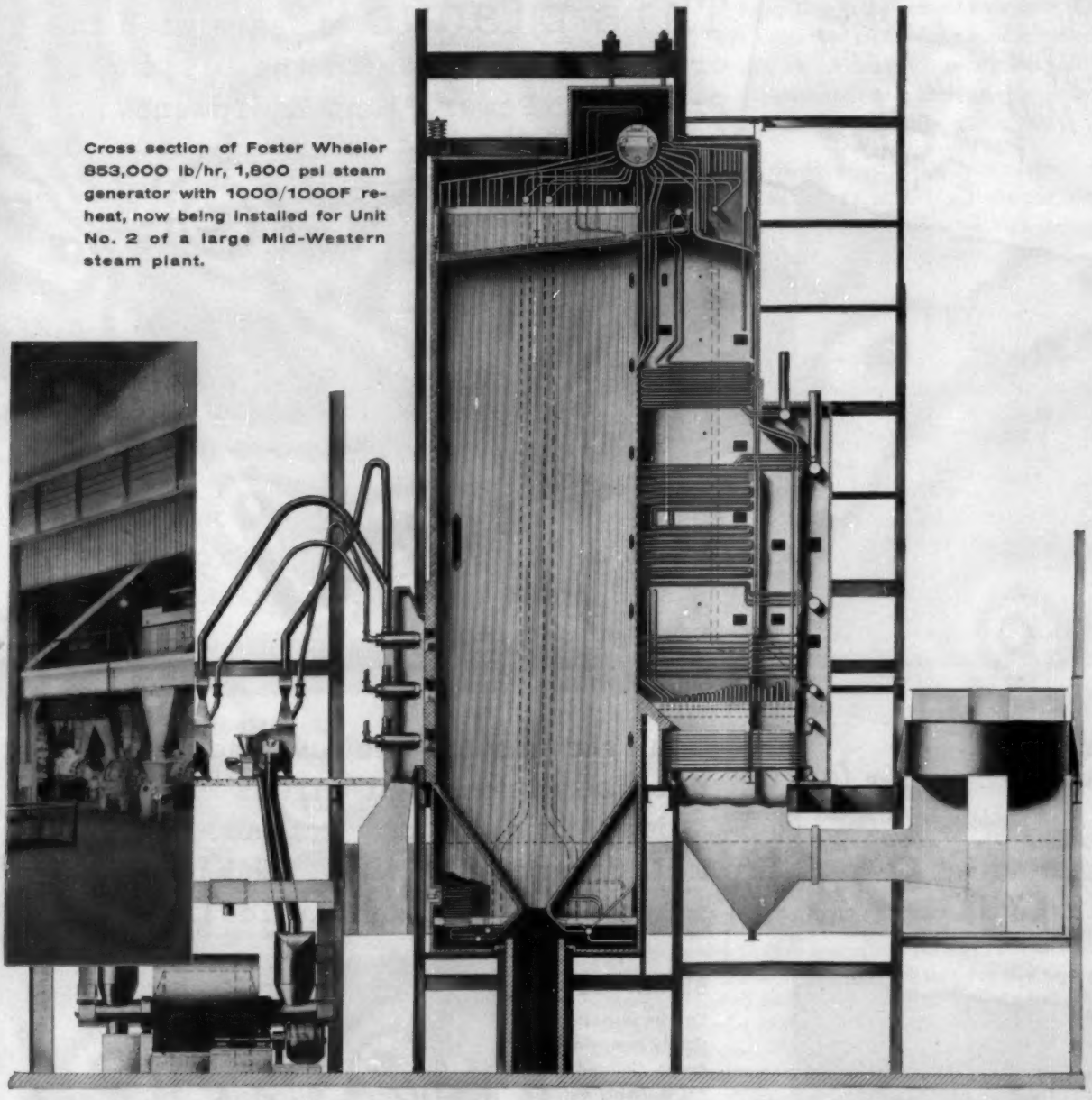
View from turbine floor of unit No. 1, put on line in Nov. 1954, showing 100,000-kw turbo-generator and exhausters of FW pulverizers for 925,000 lb/hr FW steam generator.

LONDON • NEW YORK • PARIS • ST. CATHARINES, ONT.

installing

STEAM GENERATOR

Cross section of Foster Wheeler 853,000 lb/hr, 1,800 psi steam generator with 1000/1000F reheat, now being installed for Unit No. 2 of a large Mid-Western steam plant.



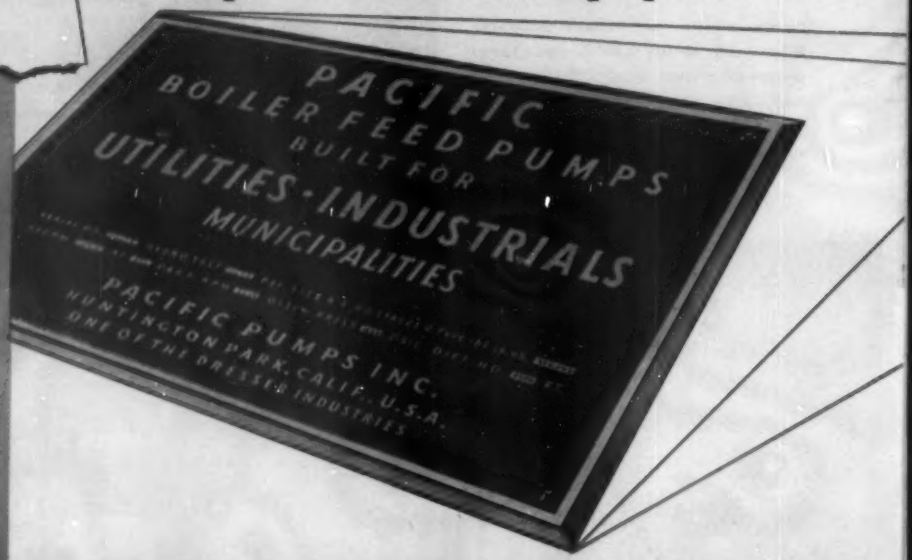
FOSTER WHEELER

For more data circle 507 on Post Card

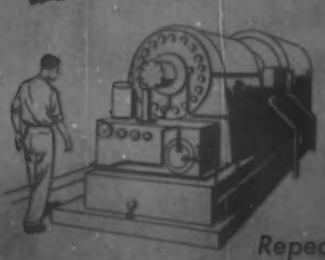
Facts* about

MEMO:
- of importance to Mechanical and Financial Engineers

This plaque appears with increasing frequency in the Listing of Principal Power Plant Equipment...

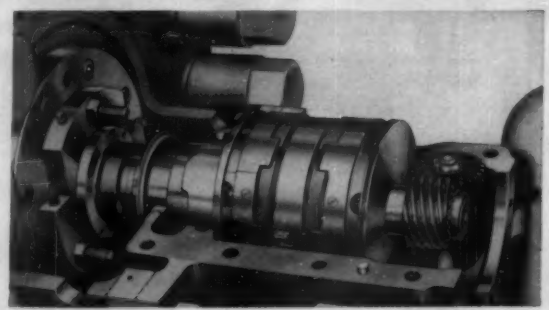


MEMO:
- of importance to Operating and Maintenance Engineers



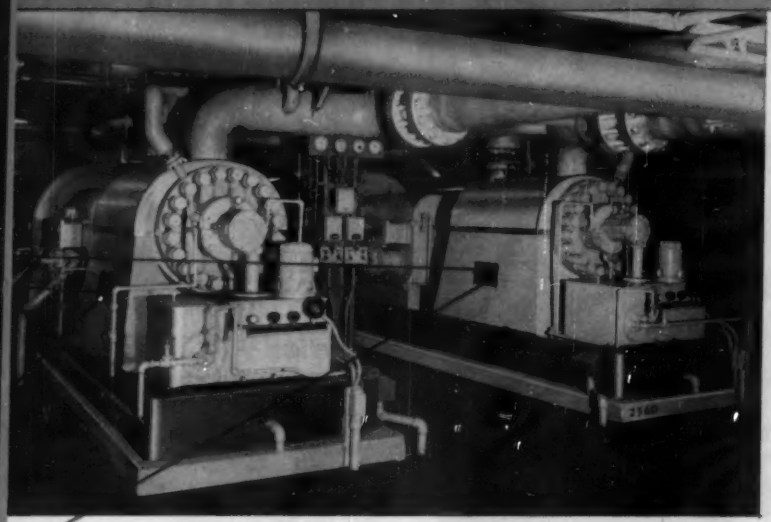
Your **PACIFIC BOILER FEED PUMPS** never need be dismantled unless there is a drop in capacity or head...then maintenance is easy...and because it is easy, the cost is low!

BEARINGS:
Can be inspected by simply removing the covers. Unitized internal assembly may be removed from the case and dismantled without heating the impellers or other parts.



Repeat orders from Utilities vary from 3 to 13 units—average 6 or more units!
Absolute evidence of Pacific's superiority in Performance—Economy—Service!

PACIFIC® BOILER FEED PUMPS



● From 1950 to the present time more than 600 boiler feed pumps have been installed by Pacific for feedwater temperatures to 450° F ... capacities to one-million pounds-per-hour with discharge pressures to 2990 psig.

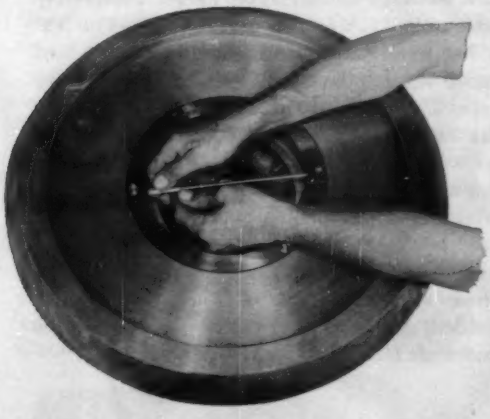
From the plain cylindrical case ... the unitized internal assembly ... the one, ring-type pressure joint ... the one, high pressure breakdown ... to bearings pressure lubricated with filtered, cooled oil, the design emphasizes simplicity with efficiency.

Precision workmanship is emphasized at every step from magniflux inspection of castings through boring ... turning ... grinding ... to dynamic balancing of rotating parts.

The chrome content of all parts fabricated from alloy steels is varied for depth hardening and resistance to corrosion-erosion.

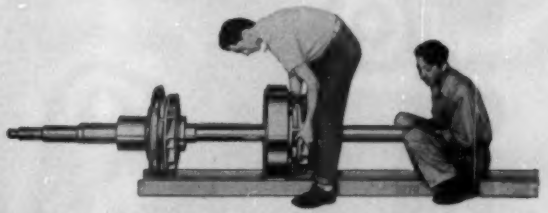
because it meets the Industry's 3 basic requirements... There is no cost compromise in the Design, Workmanship, Materials in

PACIFIC HIGH-PRESSURE BOILER-FEED PUMPS



MICROMETER CHECK-UP:

The accuracy of all internal bores can be checked *exactly*...not by guess...easily and quickly because of Pacific's superior design.



UNITIZED INTERNAL ASSEMBLY:

May be assembled by two men without the aid of a torch or other heating devices—thus eliminating shaft distortion due to uneven heating and cooling during assembly operation. There is no critical lateral adjustment of shaft after unitized internal assembly is installed in the case.

PACIFIC®

PACIFIC PUMPS INC. HUNTINGTON PARK CALIFORNIA

Export Office: Chanin Bldg., 122 E. 42nd St., N.Y.

Offices in all principal cities

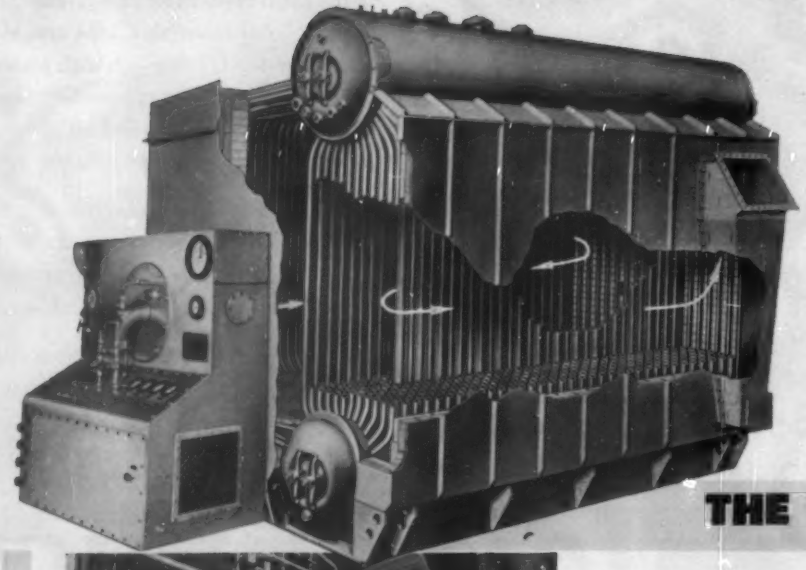
BF-21

For more data circle 508 on Post Card

FOR STEAM CAPACITY
choose your boiler

Whatever your fuel . . . whatever your steam capacity requirements up to 60,000 pounds per hour — you'll find one of the C-E Boilers shown here will be just right for you.

If you burn oil or gas, investigate the VP Pack-



Specifications — VP Boiler

Capacity — 4,000 to 40,000 pounds of steam per hour

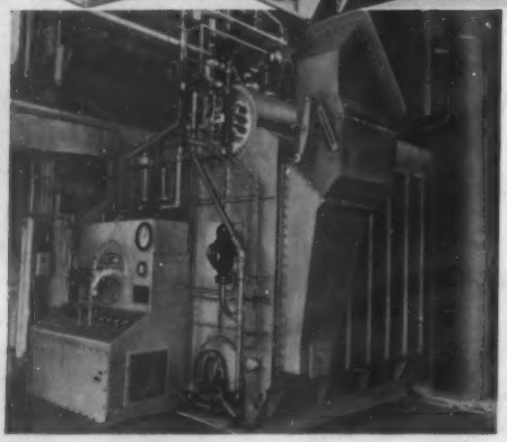
Pressures — Up to 500 pounds per square inch

Fuel — Oil or gas

Erection — Completely shop-assembled

Foundation — Simple concrete slab

THE VP BOILER



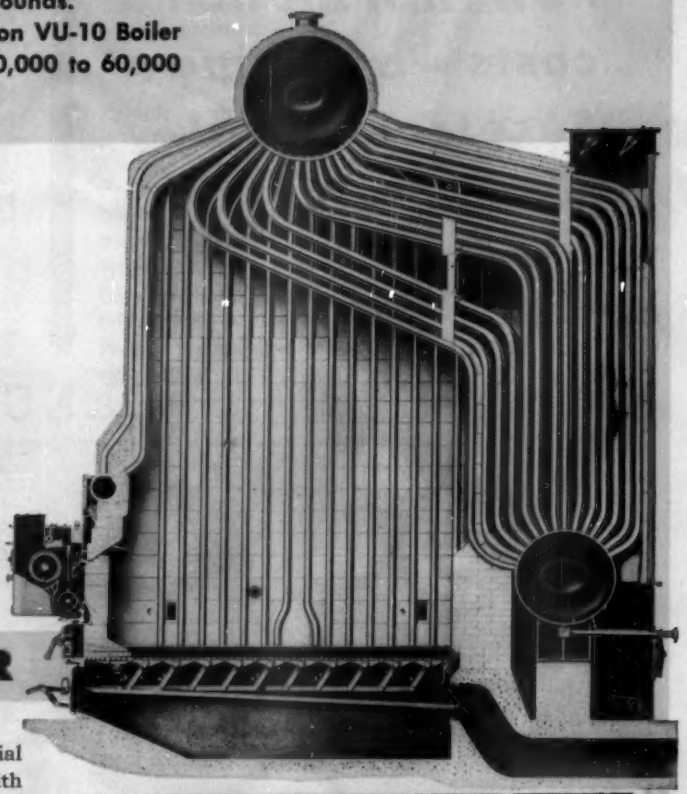
The C-E Package Boiler, Type VP . . . completely shop-assembled . . . for oil or gas firing. The VP Boiler has more water-cooled area per cubic foot of furnace volume than any other boiler of its size and type. The large (30-in. diameter) lower drum permits a simple, symmetrical, tube arrangement... greater water storage capacity . . . easy access for washing down or inspection. A low-speed, centrifugal fan which is exceptionally quiet in operation, is standard equipment. Baffle arrangement is simple, resulting in low draft loss . . . simple soot blowing . . . high heat absorption. The unit is pressurized . . . has welded, gas-tight, steel casing . . . requires no induced-draft fan. Write for Catalog VP.

COMBUSTION ENGINEERING

UP TO 60,000 POUNDS
from these two

age Boiler for capacities up to 40,000 pounds per hour . . . the VU-10 up to 60,000 pounds.

For stoker firing, the Combustion VU-10 Boiler is available in capacities from 10,000 to 60,000 pounds of steam per hour.



Specifications — VU-10 Boiler

Capacity — 10,000 to 60,000 pounds of steam per hour

Pressures — Up to 475 psi

Temperatures — Superheat available if desired

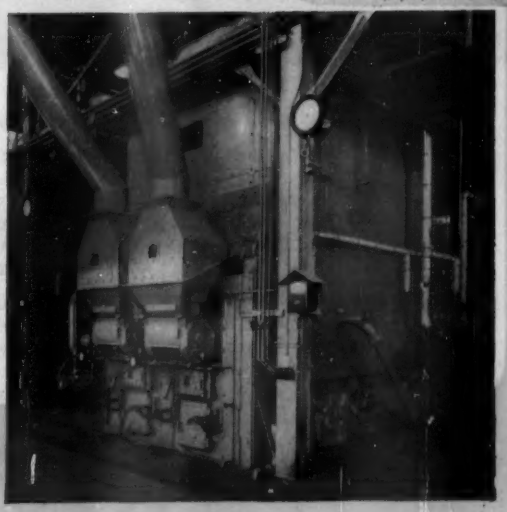
Heat Recovery — Economizers, air heaters available if desired

Fuel — Coal (C-E Spreader, Traveling Grate or Underfeed Stoker); oil or gas.

Erection — Field erected

THE VU-10 BOILER

The VU-10 Boiler is designed for industrial load conditions, particularly for plants with small operating and maintenance forces. Fuel can be either coal, oil or gas. This boiler is a completely standardized design adaptable to many conditions. It responds readily to variations in load; it is simple to operate and maintain. All parts are easily accessible for inspection. Like the VP, the VU-10 Boiler is a complete unit — boiler, furnace setting, fuel-burning equipment, controls, forced draft — bringing you the benefit of one contract . . . one guarantee . . . one responsibility. Write for Catalog VU-10-8. B-858



C-E

BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE.

For more data circle 509 on Post Card

"We eliminated Motor Burnouts and cut new installation costs – by using Fusetron dual-element Fuses!"

"Our organization services some 43 Alfalfa Mills in the central Nebraska area.

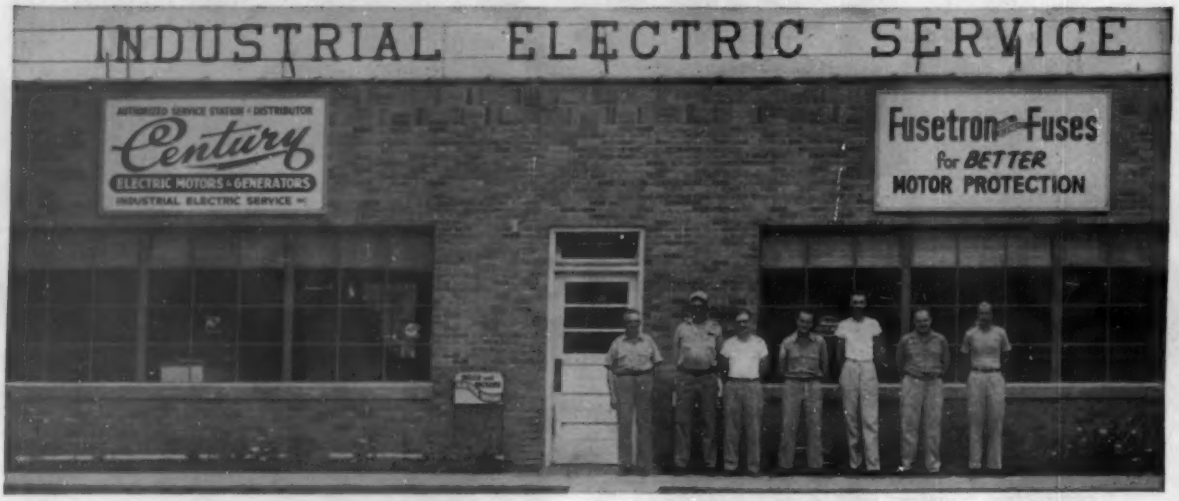
"We know, from experience, that overloads and single phasing are two of the most common causes for motor failures in these mills.

"In order to give these motors the protection they need, we use Fusetron fuses in motor-running protection sizes. As a result, we have eliminated motor burnouts for our customers.

"In addition, on new installations, we have found that smaller switches can be used with proper size Fusetron fuses.

"We can pass this substantial saving along to our customers and still give them safer protection than can be had with ordinary protective devices."

Max T. Moore, Vice-President
Industrial Electric Service, Inc.
Kearney, Nebraska



Here's why Fusetron dual-element fuses give DOUBLE protection to large motors

Of course, large motors are protected with thermal cutouts or overload relays. But experience has shown that such devices sometimes stick or fail to operate. When they do, the motor burns out.

On normal installations, by replacing fuses used for short-circuit protection with Fusetron fuses of motor-running protection size, you get the same short-circuit protection PLUS double protection against motor burnout from overload or single phasing.

If thermals or relays fail to operate for any reason, the Fusetron fuses will act independently to SAVE THE MOTOR.

And Fusetron fuses protect against waste of space and money — permit use of proper size panels and switches.

On motor circuits Fusetron fuses can be used in sizes near to the operating load. That cannot be done with ordinary fuses. It is possible with Fusetron fuses because they have a tremendous time-lag that prevents them from opening on starting currents or other harmless overloads.

This means that on new installations for motor circuits you can save space and money because *proper* size Fusetron fuses permit using *proper* size switches and panels instead of *oversize*.

You too, can profit by the 10 point protection of Fusetron fuses

1. High interrupting capacity — protect against heaviest short-circuits. Have proven on tests to open safely on circuits set to deliver in excess of 100,000 amperes.
2. Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation.
3. Protect against needless blows caused by harmless overloads.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. **Protect against waste of space and money — permit use of proper size switches and panels.**
6. **Protect motors against burnout from overloads.**
7. **Give DOUBLE burnout protection to large motors — without extra cost.**
8. **Protect motors against burnout due to single phasing.**
9. Make protection of small motors simple and inexpensive.
10. Protect coils, transformers and solenoids against burnout.

For more information on Fusetron fuses write for bulletin FIS.

On new construction, tell your architect to specify this Safer, Better Protection.

FOR LOADS ABOVE 600 AND UP TO 5,000 AMPS . . . USE BUSS HI-CAP FUSES

They have unlimited interrupting capacity to handle any fault current regardless of system growth.

They can be coordinated with Fusetron fuses on feeder and branch circuits to limit fault outages to circuit of origin.

Write for bulletin HCS.

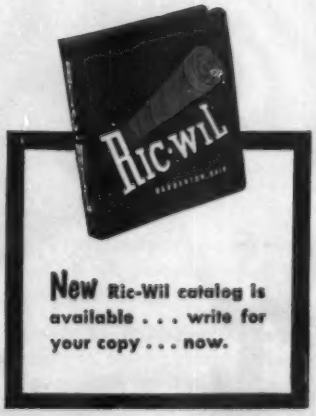
BUSSMANN MFG. CO. (*Division of McGraw Electric Co.*) UNIVERSITY AT JEFFERSON ST. LOUIS 7, MO.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

For more data circle 510 on Post Card

Delivery...ON TIME...

A delay on this particular job meant valuable time lost . . . dollars wasted . . . Ric-Wil, not only prides itself in offering the finest in prefabricated insulated piping, but takes pride in ON TIME DELIVERY . . . and speaking of delivery . . . the best way to meet piping construction schedules is to contact your Ric-Wil representative early in the planning stage. He will be glad to help on scheduling delivery . . . and "lend a hand" on technical information as well.



New Ric-Wil catalog is available . . . write for your copy . . . now.

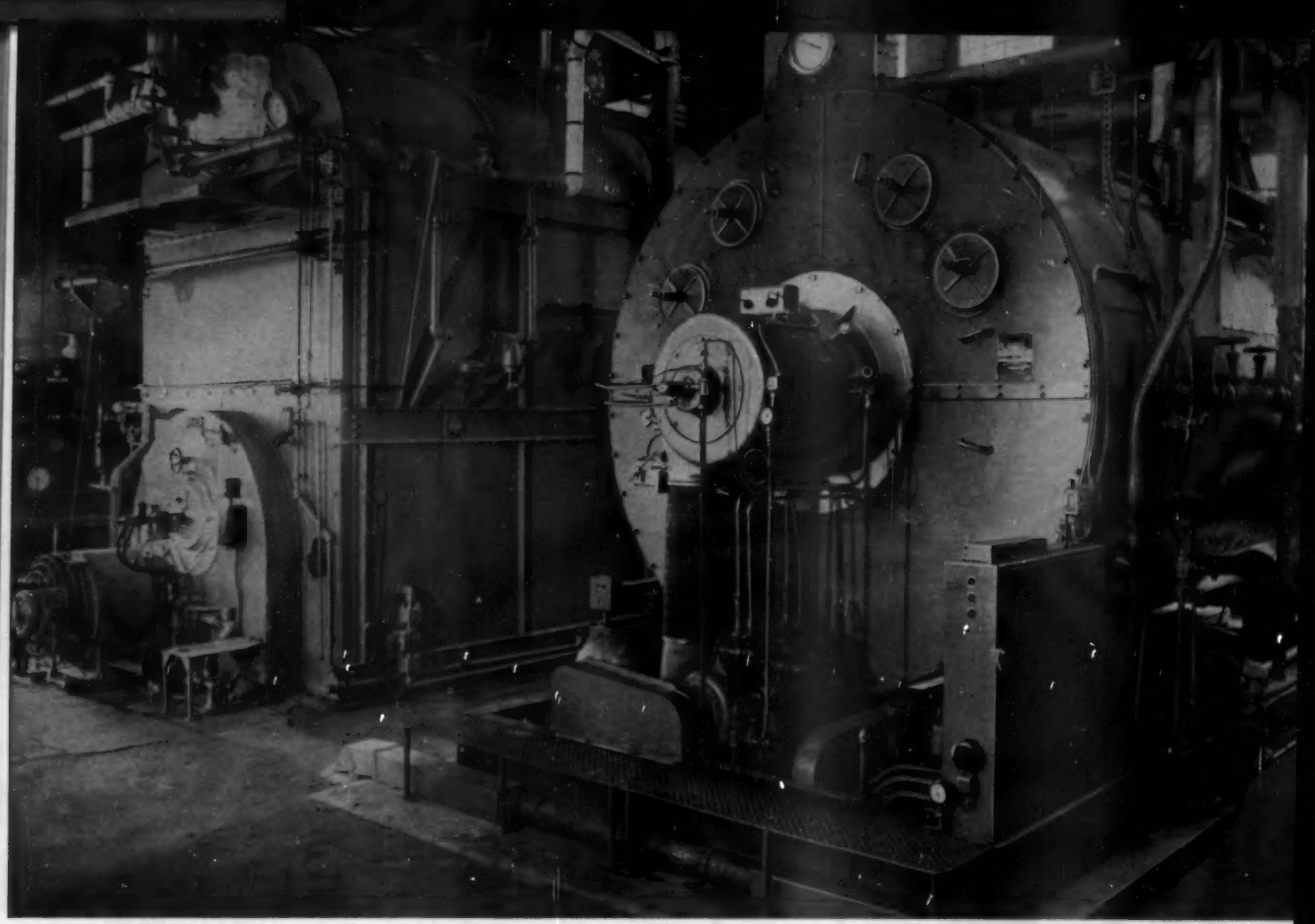
Quality Piping Systems . . .
. . . of Exceptionally High Thermal Efficiency

RIC-WIL INCORPORATED

PREFABRICATED INSULATED PIPING SYSTEMS

BARBERTON, OHIO

For more data circle 511 on Post Card



Why was this *Powermaster*® switched from "Stand-by" to Full-Time Duty?

You get MORE than fuel economy with Powermaster

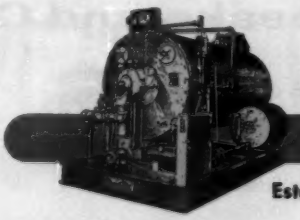
- ★ Low-cost, space-saving installation
- ★ Fast steaming
- ★ Instant response to load changes
- ★ Quick fuel change-overs
- ★ Clean, dry steam
- ★ Automatic operating and safety controls
- ★ Clean, quiet operation
- ★ Smokeless combustion
- ★ One-source responsibility for complete unit
- ★ Nation-wide factory-trained service organization
- ★ Pay-As-You-SAVE Purchase Plan

Originally purchased as a stand-by unit to supplement two older water-tube boilers, this 500 HP heavy oil *Powermaster* Packaged Automatic Boiler was quickly put on full-time duty by an Eastern rubber goods company.

The reason is *Powermaster's* fuel economy. While the *Powermaster* now carries the plant load continuously, the older boilers, one of which is shown at left above, are operated only when necessary.

Powermaster's cost-cutting and worry-saving advantages can be yours quickly and easily under Orr & Sembower's new Pay-As-You-SAVE Purchase Plan.

Write for Bulletin 1220.



Powermaster®

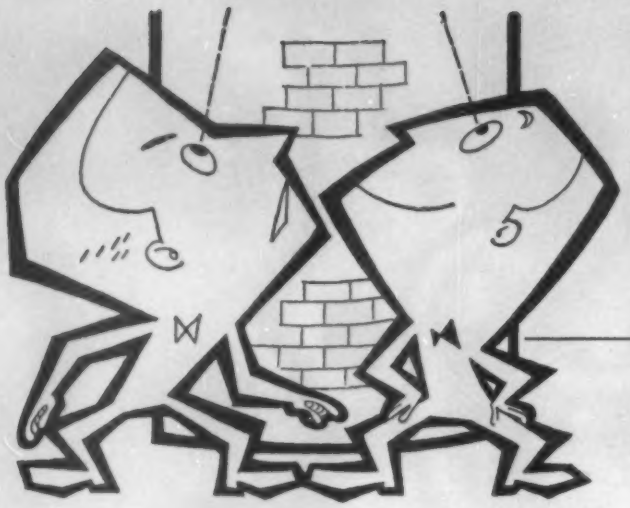
PACKAGED AUTOMATIC BOILERS

In sizes to 500 HP; pressures to 250 psi.

ORR & SEMBOWER, INC.

Established 1885 • Morgantown Road, Reading, Pa.

For more data circle 512 on Post Card

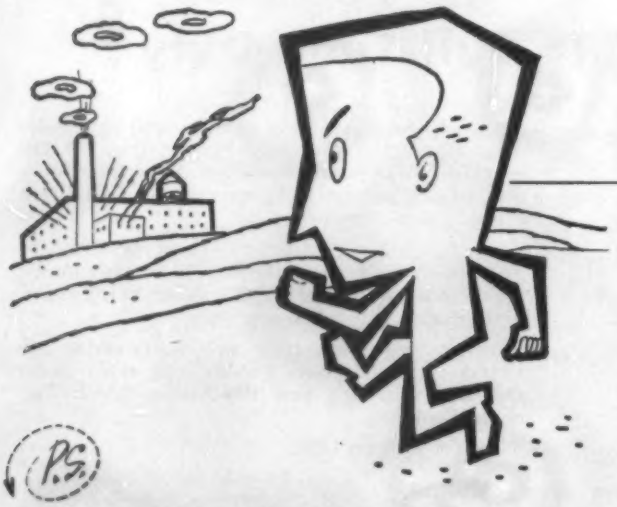


Your chimney never smokes any more. Did you change to another fuel?

We just changed to another kind of coal. And man! Does it make a difference! No smoke. No clinkers. No trouble. And very few ashes.

What kind of magic coal is this?

It's one of the superior quality coals produced on the Chesapeake and Ohio. But the important thing is that it is exactly right for our type of installation.



Say, I've got to look into this! We're always having boiler room trouble at our plant.

Picking the right coal is a job for an expert. I never realized there were so many things to consider. Size, moisture, sulphur, ash softening temperature, etc., as well as BTU's.

Why don't you write to the C&O coal people? Tell them your problem and describe your boiler equipment. They'll help you find the very best coal for your particular condition.

P.S.

There's a lot more to buying coal than the cost per ton. Why not contact coal producers on the C&O to solve your particular fuel requirements, or write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake and Ohio Railway Company, Terminal Tower, Cleveland 1, Ohio.

Chesapeake and Ohio Railway

WORLD'S LARGEST CARRIER OF BITUMINOUS COAL

For more data circle 813 on Post Card

POWELL VALVES . . . THE COMPLETE QUALITY LINE . . . POWELL VALVES

FIG. 3031 WE—Steel O.S. & Y. Globe Valve For 300 Pounds W.S.P.

FIG. 11303—1500-Pound Pressure Seal Steel Gate Valve.

FIG. 1331-A—1500-Pound Steel Integral Bonnet Offset Globe Valve.

FIG. 3059-G—300-Pound Steel Lubricated Plug Valve. Gear Operated.

POWELL VALVES . . . THE COMPLETE QUALITY LINE . . . POWELL VALVES

THE COMPLETE QUALITY LINE . . . POWELL VALVES . . . THE COMPLETE QUALITY LINE . . .

Why Power Engineers Specify Powell Valves . . .

. . . *because they know Powell Valves are dependable and economical.* Power engineers also know that Powell has *the COMPLETE quality line of valves.*

Investigate the many outstanding features of the Powell Valves shown here . . . as well as *the complete line* of quality valves that have a proven record of long life and dependable service.

Consult your Powell Valve distributor. If none is near you, we'll be pleased to tell you about our complete line, and help solve any flow control problem you may have.

The Wm. Powell Company, Cincinnati 22, Ohio . . . . . 109th year

POWELL VALVES

For more data circle 514 on Post Card

today's most complete advanced design

- **863 Models** in three Basic Pressure Groups.
- **Capacities** from 2 cc. per hour to 15,000 gal. per hour.
- **Pressures** to 50,000 psi.
- **Mediums Handled.** Any liquid that will flow to the Pump—clear free-flowing, viscous, tarry materials and slurries—corrosive mediums such as acids, alkalies, salts, oxidizing and reducing agents, etc.
- **Capacity Control**—manual or automatic for proportioning in relation to temperature, time, flow, pH value, liquid level, pressure, color, conductivity or any other meterable factor.
- **Metering Accuracy** to two-tenths of one percent with automatic control mechanisms.

Now, no matter what your chemical proportioning problem—you will find the answer at PHILADELPHIA PUMP, "headquarters" for the most complete line of Controlled Capacity Pumps.

Advanced Design Offers Savings In First Cost and Maintenance

Pump users actually wrote the specifications for PHILADELPHIA PUMPS. For their design is the result of an industry-wide survey of pump users' practical experience on "what is wrong with the proportioning pumps you are using."

Simplification and standardization of basic features, and more efficient production methods, have answered the first complaint—High First Cost. Model for model, PHILADELPHIA PUMPS are lower in price.

Prevalent points of failure—cross-heads, connecting rod bearings, pressed valve seats, packing, etc.—have been corrected through advanced design and better materials of construction.

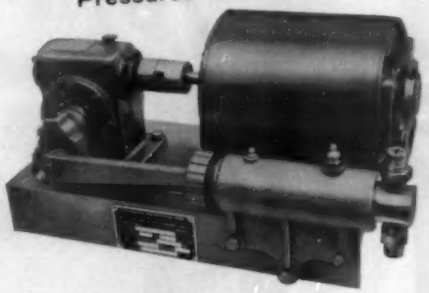
High Maintenance Costs—excessive down time and labor—have been eliminated by a design which permits the removal of all moving parts and packing through the oversize cross-head without breaking piping connections.

Proved by Years of Service In Leading Plants

Repeat orders testify to user satisfaction, and it is significant that engineers who know pumps best, men who purchase quantities of them annually for some of the largest plants—prefer PHILADELPHIA PUMPS.

It will pay you to investigate. Write for catalog.

Pressures to **800** psi



LP Series The Phila-Feeder controlled capacity Proportioning Pump—a low cost, high quality pump popular for feeding water treating chemicals into steam boilers. Made in simplex and duplex types for maximum capacity to 18 gph. Adaptable to manual or automatic control.

Packaged Chemical Feed Units

PHILADELPHIA PUMP offers many standard and special designs of self-contained Units to meet all chemical feed requirements.

Unit illustrated is for feeding water treating chemicals. It comprises welded steel storage tank, Phila-Feeder duplex pump and all necessary auxiliaries and piping ready to connect to chemical feed piping and electrical circuits.

Other special Chemical Feed Units developed by PHILADELPHIA PUMP include:

- Oil Well Chemical Treating Systems
- Natural Gas Odorizing Units
- Special Chemical Mixing & Proportioning Units

• *Sales Engineers in principal industrial centers in the United States, Canada, Mexico, and abroad.*

PHILADELPHIA

line of proportioning pumps

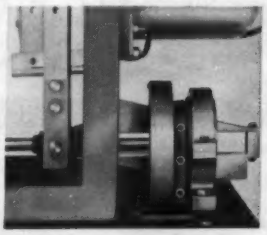
Pressures to **1500** psi

S Series

Made in simplex and duplex types for maximum capacity to 3300 gph. The standard proportioning pumps for most Processing Industry requirements and for treating of boiler water, municipal and industrial water, and sewage.

The pump illustrated is equipped with rocker-arm micro-adjustment of pump capacity while running.

The PHILATROL Automatic Control



This patented control mechanism for exceedingly accurate proportioning in relation to any meterable factor, adjusts piston stroke and hence pump capacity in response to manual, hydraulic, pneumatic or electrical motivation. It permits continuous stepless adjustment from zero to maximum and eliminates the "hunting" characteristics of other mechanisms with coarser adjustments.

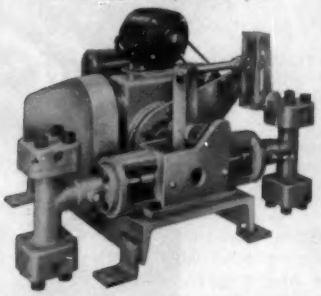
Illustrated is Philatrol Mechanism installed with air actuator on PHILADELPHIA PUMP used in gas odorizing. This pump has maintained metering accuracy within plus or minus two-tenths of one percent.

The UNI-FEEDER Automatic Control

Uni-Feeder single-revolution-clutch operated PHILADELPHIA PUMPS inject one or as many as 72 or more measured slugs of fluid per minute according to a time cycle or flow, color, concentration, or any other meterable factor.

Uni-Feeder Pumps are available with minimum capacities from .000093 gallons to maximum capacities of 27 gallons per minute.

Pressures to **50,000** psi



HP Series

These PHILADELPHIA PUMPS, designed for higher viscosities and pressures, are available in simplex, duplex and quadruplex types and in capacities from 2 cc. to 15,000 gph.

Like all PHILADELPHIA PUMPS, they are adaptable to both manual and automatic control of capacity.

The design of these pumps offers mechanical advantages which permit reduction in horsepower normally required by as much as 30 percent.

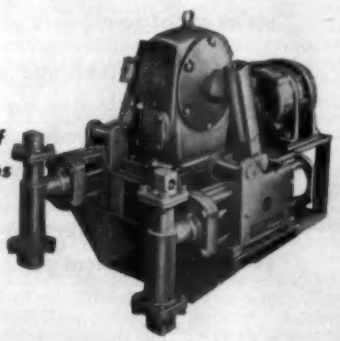
Differential Pressure Pumps

PHILADELPHIA PUMPS of the HP Series also offer a design feature which permits them to utilize the energy incorporated in any suction pressure to decrease the amount of horsepower required to produce the desired discharge pressure.

For example, if suction pressure is 2000 psi and discharge pressure is 3000 psi, the pump requires powering only for the differential pressure of 1000 psi, plus a small addition for friction losses. Consequently, great savings in first cost (motor, gear reducer, etc.) and operating cost can be effected.

See Our Exhibit at the 25th Exposition of Chemical Industries

December 5-9 1955



PUMP AND MACHINERY COMPANY

PHILADELPHIA • PENNSYLVANIA

SUBSIDIARY OF AMERICAN METER COMPANY / EST. 1836

For more data circle 515 on Post Card

JACK FROST

at 406° F.

MAGNIFIED fifty times, the calcium carbonate scale in the photo above might easily be mistaken for a frosted window pane. It was formed at 250 p.s.i. in one of the Nalco Laboratories' test boilers as a part of the continuing Nalco research program, aimed at keeping such scales *out* of your power plant equipment.

Whether your feedwater and plant conditions produce this type of scale — or any of hundreds of others — your Nalco Representative has the proved solution for eliminating scale or corrosion from raw water inlet to and through condensate return lines . . . permanently . . . economically. Check with him today — or write direct for fast action on your water treatment problems.

DO YOU RECEIVE "Nalco ABSTRACTS"?

"Nalco ABSTRACTS" is a quarterly publication containing abstracts of general and technical articles of interest to power plant engineers. If you, like most of us, find too little time to read, "Nalco ABSTRACTS" can be of real help in keeping you up-to-date on current developments. Your copies will be sent free upon request.

NATIONAL ALUMINATE CORPORATION
6224 W. 66th Place • Chicago 38, Illinois
Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario

THE Nalco® SYSTEM...Serving Industry through Practical Applied Science

For more data circle 516 on Post Card

HELPFUL BULLETINS

INSTRUMENTS AND CONTROLS

101 Regulator Controls — Specific regulator problems and solutions are treated in 36-pp Bulletin 1094. Describes 16 distinct gas regulation situations in which "special" controls are called for, including both high- and low-pressure regulator arrangements. Consideration of the problems and solutions are presented by use of full pages of text with a facing page of cross-sectional schematic drawings Meter and Valve Div., Rockwell Mfg. Co.

102 Control Components — Stepping switches, relays and key switches for industrial use are described briefly and pictured in Circular 1843. Descriptive matter covers their functions, specifications. Automatic Electric Sales Corp.

103 Purge Meter — Bulletin 135 describes a new concept in metering small flows of liquids or gases — the Sho-Rate 50 Purge Meter. Complete description of various models and accessories, together with capacity charts and dimension drawings are included. Brooks Rotameter Co.

104 Venturi Insert Nozzle — Bulletin 130-K3A discusses the savings in power realized through the use of a venturi insert nozzle designed for metering liquid, steam, air, or gas. Describes design and operation advantages, and includes capacity table, diagrams. Builders-Providence, Inc.

105 Switches and Governors — Eight-pp Bulletin 504S outlines advantages of company's line of speed sensitive switches and overspeed governors. Includes dimensional drawings of the overspeed, underspeed, one, two and three switch governors with explanations of the various types of take-off and connectors. Synchro-Start Products, Inc.

106 Temperature Instruments — Filled thermal systems for indicating, recording, controlling, transmitting, compensating, and programming temperatures from −400 to +1000 F are described in 24-pp Catalog 12-A-10. Covers vapor pressure filled systems and includes tables comparing temperature ranges and other properties of the three systems. Sensitive bulbs, union connected bulb assemblies, bushings and wells are shown. Includes temperature recorders, indicators, dial indicators, recording controllers, indicating controllers, indicating and non-indicating transmitters, program recording controllers, psychrometric instruments. Fischer & Porter Co.

107 Flow Measurement In Sewage Works — Bulletin Ref. B-I-F M39, 20-pp, is an article discussing flow measurement in sewage works. Complete with photos, tables, flow diagrams and dimension sheets, it covers fundamentals, principle devices used and, secondary instruments, controls, operation, and maintenance. Builders-Providence, Inc.

108 Water Treatment Instrumentation — Instrument control for water treatment plants is described in 12-pp Bulletin 90-241-10. A flow sheet illustrates applications possible in a large municipal water treatment system. Features company's filter operating table, includes a flow diagram showing system for operation of rapid sand filters by means of modern instrumentation. Operation of filter table is described in detail. Instruments described include standard, portable, and automatic proportioning chlorinators, flow meters, residual chlorine analyzers, pH and oxidation-reduction-potential meters, others. Fischer & Porter Co.

109 For Special Recording Jobs — "Technical Notes" includes 16 specification bulletins for those who require special recording charts. Subjects of the bulletins are chart paper, heat sensitive and electro sensitive papers, roll chart core sizes and punch sizes, others. Technical Charts, Inc.

MECHANICAL POWER TRANSMISSION

110 Reference on Gear Making — Handsomely illustrated this 44-pp brochure provides many views of gear-making operations. Shows principal types of gears, covers modern methods and techniques of gear testing, and explains trends in gearometry. Engineering graphs and tables, embodied in a gear design formula are included, along with other tabular matter and technical views. Subjects treated in this brochure include causes of early tooth failure, gear movement, use of smaller gears for given loads, costly load errors, hobbing, plating of gears. Includes a set of standardized gear specifications. Sier-Bath Gear & Pump Co., Inc.

111 Dry Fluid Drive — Bulletin A-640, 12-pp, discusses operating advantages of Flexidyne — company's dry fluid drive. Illustrations, cross-section drawings of drive with taper-lock sheave and coupling with taper-lock bushing are included. Bulletin also shows two methods of selection with use of selection charts. Dimensional drawings, explanation of flow charge (dry fluid), and thermal protecting unit, as well as recommended V-belt drives and list prices included. Dodge Mfg. Corp.

112 Friction Clutches — Eight-pp Book 2637 describes company's improved friction clutch for power transmission applications, especially suited for applications where increased speeds prohibit use of jaw clutches and where gradual pickup is a must. Illustrates and discusses application for each of three types — mounting sleeve, mounting ring and coupling. Contains horsepower and dimension tables and instruction for selecting correct clutch. Link-Belt Co.

113 Rolling Bearings — Bulletin A-638, 52-pp, features company's line of ball bearing pillow blocks, and flange cartridge mounts, as well as technical information and list prices on complete line of ball and roller bearings. Tabular data includes engineering drawings, dimensions, shaft sizes, weights, radial load ratings and list prices. Product illustrations, including cutaway views showing inner construction, are included. Dodge Mfg. Corp.

HEATERS, HEATING

115 Heater Exchange Plan — Bulletin 155-A gives details of a unit heater exchange plan for modernization and standardization of industrial heating systems. Explains how plan permits trade-in of old unit heaters on new ones of an equivalent size and type at liberal exchange prices. Modine Mfg. Co.

116 Warm Air Heaters — Catalog GC-4-55 contains a cut-away illustration of a Thermobloc heater, photographic reproductions of five models as well as dimension drawings on floor set and suspended models. Installations shown. Thermobloc Div., Prat-Daniel Corp.

New and revised publications reviewed on these pages offer help on operating and maintenance problems. To order, use the Reader Service Cards on page 117. When ordering catalogs, allow time for us to relay your requests to the manufacturers—and for them to mail out copies. Remember, manufacturers are often swamped with catalog requests.

117 Heat Transfer Apparatus — Condensed Bulletin HT-1 highlights representative products in company's line of heat transfer equipment. Includes oil heaters and coolers, strainers, evaporators, heat exchangers, radiafin air coolers, tubes, pipes, and coils. Cross-section views of typical units are shown, brief descriptions given, and references to other bulletins are listed. Schutte and Koerting Co.

VALVES, TRAPS, PIPING AND ACCESSORIES

118 Iron Body Gate Valves — Form 1005 describes company's line of iron body gate valves that have 150 lb steel valve features built into them. Sectional views illustrate chief features and a trim chart and general dimensions table is included. Standard models are pictured and described. The Ohio Injector Co.

119 Diaphragm Valves — Specification Sheet 429 covers company's line of diaphragm control valves, designated Series 400. Data include actuator and body specifications, flow characteristics and complete dimensions for double-seated, single-seated and three-way types. Minneapolis-Honeywell Regulator Co.

120 Air Release Valves — Eight-pp Bulletin 1204 describes company's Type AGFD automatic air release valves, which provide a small unit having the functions of releasing automatically air accumulations from systems and pipe lines operating under pressure. Listed in bulletin is information on essential requirements, methods of installation, operation, construction, uses, weight, and dimensions. Simplex Valve & Meter Co.

121 Stainless Tubing and Pipe — Bulletin TB-355, 6-pp, touches briefly on

attributes of stainless steel and how it can be fabricated. Also included are tables of analyses, mechanical properties, creep strength, physical properties, oxidation resistance of nine stainless tubing steels. Tubular Products Div., The Babcock & Wilcox Co.

122 Cast-Steel Steam Trap — Section 230 describes company's Model 7 CS cast-steel steam trap, an inverted bucket type of trap which is efficient, low cost and designed for fast removal of condensate from higher pressure steam lines. Specifications and cut-away views are included. The Clark Mfg. Co.

123 Tube Fittings — Twelve-pp Catalog 4324 presents a line of flareless type fittings especially for instrumentation lines. Elbows, unions, crosses, tees, reducers and ferrules are pictured and dimensions given. Fittings for use with plastic tubing are also included in this catalog. The Parker Appliance Co.

FILTERING

124 Air Filters — Bulletin 117, 8 pp, describes Poro-Stone filters for compressed air and gases. Covers operation of a filter in which movement of compressed gas is used to achieve initial separation, and second stage separation is by diffusion through a Poro-Stone element. A few of the many applications of air filtration are pictured, others listed. R. P. Adams Co., Inc.

125 Improved Oil Filters — Eight-pp Bulletin 101 describes company's Full Flow oil filters for in-line filtration of engine lube oils, fuel oils, industrial oils and coolants, solvents, washing solutions. Stresses design and application advantages of the filters, and includes specifications and dimensional data. Houdaille-Hershey of Indiana, Inc., Houdaille-Hershey Corp.

PUMPS AND COMPRESSORS

126 Plunger Pumps — Twelve-pp Bulletin W-414-B45A describes company's vertical triplex single acting plunger pumps with capacities to 225 gpm and pressures to 11,700 psi. Information is presented on use of these pumps in water flooding and salt water disposal, hydraulic press systems, hydraulic descaling systems, petroleum industry and other industrial process pumping. A rating chart lists data on size, speed, displacement, discharge pressure. Outline drawings, along with specifications and data on general dimensions are included. Worthington Corp.

127 Proportioning Pump — Application Memo B-I-F M-37 discusses the continuous proportioning of chemicals into boiler feed water to increase safety, to prevent corrosion and accumulations of boiler tube sludge and scale, and to reduce costs and lost time from shutdowns. Bulletin shows one boiler treatment installation using six Adjust-O-Feeder proportioning pumps. Proportioners, Inc.

128 Hydraulic Pumps — Section I, 8-pp, of company's pump series presents technical data on their line of hydraulic oil pumps. Includes tips on selecting proper materials, construction details, dimensions and specifications, as well as performance graphs. Viking Pump Co.

129 Hydraulic Pumps, Controls — Profusely illustrated, 56-pp Catalog 5001A describes oil-hydraulic pumps, controls and accessories for general industrial application. Provides engineering, design and application information relating to pumps, pressure controls, volume controls, directional controls, control assemblies, hydraulic motors, transmission, cylinders, and hydraulic accessories. Each unit is covered in detail along with photos, cutaway views and circuit drawing where required. Application suggestions and selection tips are included. Vickers Inc.

130 Water Supply Pumps — Vertical turbine pumps for industrial and municipal primary water supply are described in 8-pp Bulletin 100. Sectional illustrations with enlarged views of special features describe products. Detailed drawings of pumping and distribution systems are also included. A condensed selection table is a valuable guide to horsepower, head-capacity ratings. Layne & Bowler Pump Co.

131 Pressure Generators — Bulletin 755 features pressure generators, designed to produce hydrostatic pressures as much as 500 times greater than normal plant air supplies. Complete information includes overall capacity pressure ranges, theory of operation and application details in high pressure synthesis, metal fabrication, hydrostatic testing, and high pressure bottle filling. Milton Roy Co.

132 Compressor Data — Feather valve compressors from 75 to 350 hp are described in 32-pp Bulletin L-676-B1A. Advantages on installation, operation and maintenance costs are outlined for Types YC and DYC compressors. Information and illustrations are offered on component parts including frame, running gear parts, intercooler, crosshead, motor and main bearings and various cutaway views are included. Variable capacity control information is listed along with data on governors. Diagram illustrates correct selection and coordination of auxiliary equipment. Worthington Corp.

MAINTENANCE

133 Maintenance Directory — Bulletin 1062 serves as a directory of products for plant upkeep and repair requirements. For wall or desk, it lists alphabetically, common maintenance problems and suggests solutions. Among maintenance jobs listed are those requiring acid-resistant coatings, anti-rust paints, dampproofing. The Monroe Co., Inc.

134 On Concrete Floors — This 12-pp booklet describes the basic concrete floor, and illustrates some of the common faults due generally to improper construction and maintenance. The terms "dusting" and "blooming" are explained and means for overcoming these problems are indicated. Cleaning, finishing, and maintenance tips for concrete floorings given. National Sanitary Supply Ass'n.

135 Coating Properties — This 19-pp report, "Comparative Properties of Protective Coatings," contains information on 14 types for protecting equipment, walls, beams, and ceilings in plants where fumes and industrial atmospheres cause corrosion. Includes physical and chemical data and a section on selection. A chart shows comparative value of various coatings as protection against weather, impact, abrasion. The Atlas Mineral Products Co.

ELECTRICAL

136 Parallel Regulation — Methods of paralleling regulating equipment by modified compensator setting are discussed in 8-pp Booklet GET-2472. Shows by text and diagrams how imbalance occurs when circulating current flow causes each paralleled regulator to misread and overcorrect true load voltage. Booklet tells how to achieve the best compromise solution of three objectives: stability, line-drop compensation, sensitivity. General Electric Co.

137 Cables For Power Distribution — The advantages of company's Powerduct cables for flexible bus-drop power distribution are outlined in this illustrated bulletin. Includes tabular data, installation tips. Anaconda Wire & Cable Co.

138 On Distribution Equipment — Two new catalogs on distribution equipment and components are available to qualified power engineers. The 1955 Quick Guide (Publication GEC-1031), 98 pp, contains list prices and brief descriptive information on products used in light commercial and industrial and other applications. These include load centers, fuse pullers, molded case circuit breakers, safety switches, lighting panelboards, plug-in trolley busway and wireways. Publication GEC-1032, company's 1955-56 general catalog, includes complete pricing and descriptive data covering products shown in the Quick Guide. Distribution Assemblies Dept., General Electric Co.

139 Making Cable Joints — Complete, step-by-step pictorial directions for making all types of cable joints in company's Neoprene-jacketed Durasheath cables are contained in this pocket-size 12-pp booklet. Booklet tells its story in photos supplemented by simple instructions. Anaconda Wire & Cable Co.

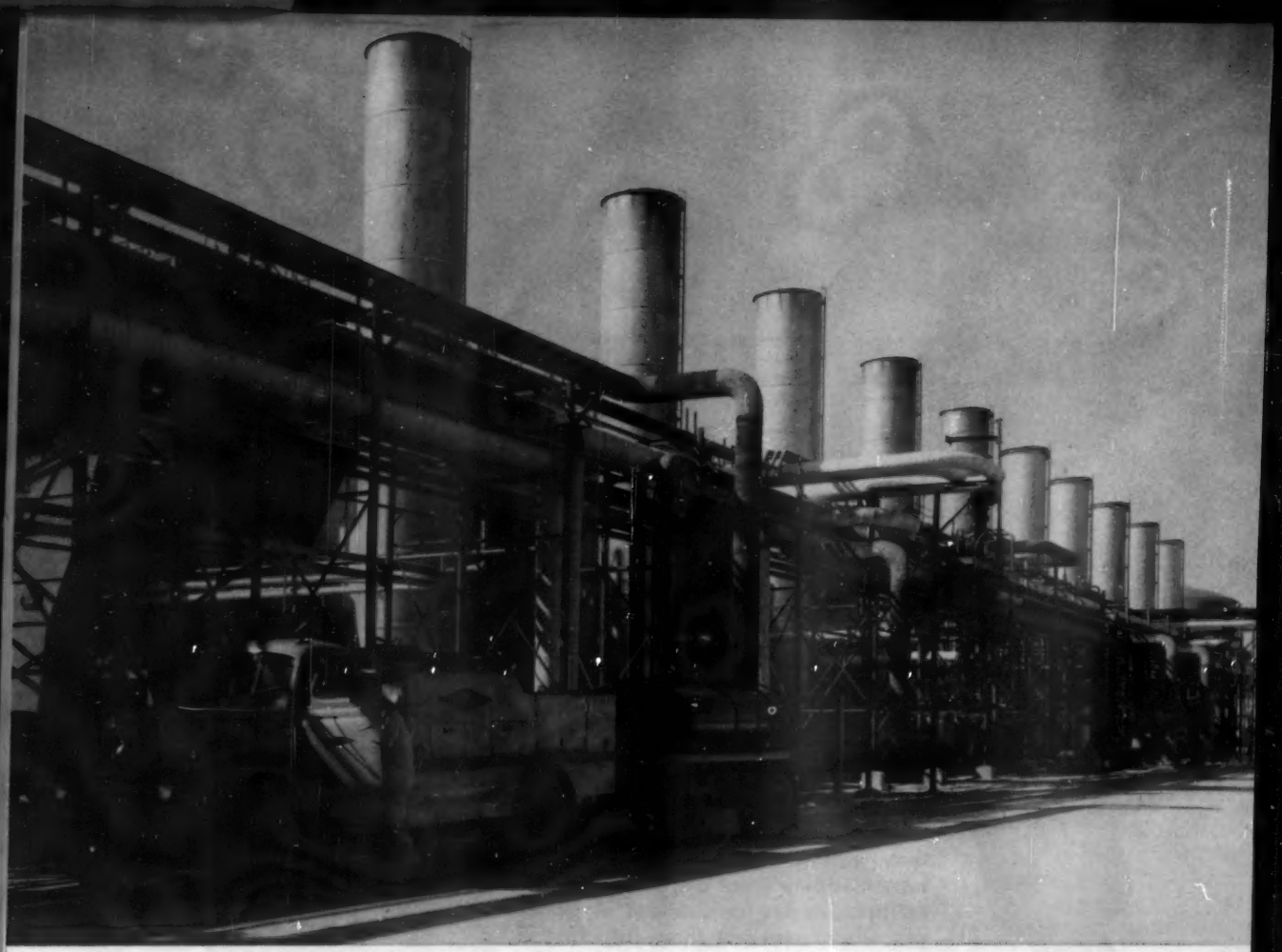
140 Lightning Arresters — This 20-pp catalog describes and illustrates lightning arresters and fuse cutouts. Explains how the lightning arresters work to provide lightning voltage protection, discharge voltage protection and lightning current protection. Use of the arresters, their design and construction are covered and several types described. Data is also provided on arrester and fuse cutout combinations, fuse kits, fuse cutouts and mounting brackets. Hubbard and Co.

141 Vault-Type Power Units — Factory assembled, vault-type power units designed as economical and compact sources of electricity in limited space areas are described in Bulletin 61B8208. Includes table of mechanical data for the units which have a standard range of from 112½ through 500 kva, 15 kv and below. Allis-Chalmers Mfg. Co.

142 Transmission Towers — Bulletin 2509 describes company's transmission towers. Body and leg extensions to both double and single circuit towers, in order to obtain desired height and meet uneven ground conditions, are discussed, diagrams included. Blaw-Knox Co.

143 Transformer Connections — Eight-pp Bulletin CS-102 features company's transformer power and lighting connections, including diagrams and explanations of operation, as well as common single phase applications. Schematic diagrams illustrate installations. Kuhlman Electric Co.

144 Suspension Hardware — Bulletin DL8A is a 44-pp ordering guide on strain and suspension hardware. Clamps, clevises, arcing horns, fittings, others are illustrated and sizes, strength, and packing



OPERATOR SAVED $440,000

DOWELL chemical cleaning of superheater avoided costly retubing and two-week boiler shutdown

Scale deposits had caused tube failures in the superheater of this 175,000-pound-per-hour boiler. To clean mechanically or replace the tubes would have required a two-week shutdown, costing $1,700 per hour in lost production. Instead, the operator chose Dowell chemical cleaning.

Experienced Dowell engineers developed special cleaning techniques for the nondrainable superheater, then used job-tailored Dowell solvents. The unit was restored to top operating condition in just 3½ days. Total saving to the operator, in cost of outage time and replacement parts, was approximately $440,000!

Dowell engineers hold downtime to a minimum by introducing solvents through regular connections. Extensive dismantling and scaffolding are not needed.

By removing corrosion products, chemical cleaning helps eliminate boiler tube failures due to overheating or galvanic attack. Prevent unscheduled shutdowns . . . keep your equipment operating at top efficiency . . . start a regular program of Dowell chemical cleaning *now*.

For more information, call any of the 165 Dowell offices in the United States and Canada. Or write directly to Dowell Incorporated, Tulsa 1, Oklahoma, Department J-24.

chemical cleaning service for industry

DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

For more data circle 517 on Post Card

PROMPT ROTOJET TUBE CLEANER SERVICE

Prevents costly delays

It is a tribute to the durability of ROTOJET Tube Cleaners that so many of them outlive the equipment for which they were bought. Why wait until your tube cleaners wear beyond repair when an inexpensive adjustment or parts replacement can put them into first class condition again?

Do This Now—

Examine your motors, hose, and couplings, and check your stock of heads and brushes. Let our trained mechanics make any necessary adjustments. Do it now, and they'll be ready when you need them.

For Prompt Service and Delivery

YOUR BEST BET IS

ROTOJET®

ELLIOTT COMPANY-ROTO DIVISION

147 Sussex Ave. Newark 1, N. J.

For more data circle 518 on Post Card

information provided. Descriptive and application information is included for each item cataloged. Line Material Co.

. . . Outstanding Among This Month's Catalogs

145 Annunciator Systems — Thirty-pp Catalog 100-A contains information on company's improved Panalarm "50" annunciator systems. All components in a modern annunciator system, together with improvements in mechanical and electrical design, are described. Charts, engineering data and National Electric Code Requirements are listed to help in selection of proper annunciator for specific application. Catalog is profusely illustrated. Panalarm Products, Inc., Div. of Panellit, Inc.

146 Motor Control — Bulletin EC-80, 44-pp, is designed to help in selecting electrical components for air conditioning, heating, ventilating, pump, and compressor equipment. Profusely illustrated, bulletin covers all major fields, and gives a wealth of motor control data tables, charts, diagrams. Cutler-Hammer, Inc.

147 Stainless Steel Products — A 16-pp engineering data book, Catalog 55, includes design and dimensional information on flange drilling templates, flange and ring-joint facings, stainless steel pipe, pipe threads, thread engagement; pressure-temperature ratings and conversion factors, resistance of fluid flow; hardness conversion tables, metal casting factors, physical and mechanical properties of stainless steel; and a detailed materials selection chart covering over 300 corrosive solutions. Cooper Alloy Corp.

148 For Pipeline Protection — Applications and property data on tape products for pipeline protection are presented in this 16-pp illustrated bulletin. Covers use of Scotchrap brand all-weather pipe wrap tapes, pipe primer, and filament No. 45 which is used for attaching rock shields to buried pipe. In addition it covers Scotchfil electrical insulation putty, Scotch plastic tape, and Scotchkote electrical coating for protecting splices in anode ground bed installations. Charts showing physical and electrical insulating properties are included. Minnesota Mining and Mfg. Co.

METALS

151 Aluminum Alloys — This 6-pp brochure describes commercial aluminum alloys, discussing general properties, fabricating characteristics, typical applications, and available size ranges of each alloy. Also included are alloy designation, weight comparison, and temper designation charts. Peter A. Frasse & Co., Inc.

152 Metal Publication List — This 16-pp pocket-size folder lists all of the company's 85 current technical data sheets and booklets. Stainless, electrical, tool and die steels, and other high alloy specialties are covered. Allegheny Ludlum Steel Corp.

153 Guide to Steels — Identified as a buyers' guide to bars, structurals, plates, sheets and strip, Bulletin 11-2 gives quick

higher loads...
economy fuels...
new
engine designs...

there's one answer for all three of these lubrication problems—

Demands upon the lubricant in stationary industrial engines are increasing. More severe operating conditions caused by heavier loads, new engine designs and the use of economy fuels pose difficult lubrication problems not met by conventional oils. Standard Oil Company introduces a lubricant specifically designed to meet these problems—STANODIESEL Oil M.

STANODIESEL OIL M

STANODIESEL Oil M meets or exceeds the requirements of a lubricant for stationary industrial engines. Here's why:

STANODIESEL Oil M is refined from the highest quality base stock. It has superior stability.

Special additives are blended with this STANODIESEL Oil M base stock. An oxidation inhibitor prevents unwanted increases in oil viscosity and prevents corrosion of bearings. The action of detergent-dispersant additives keeps crankcase, pistons, cylinder walls and other parts clean. Contaminants are kept in suspension and are prevented from depositing. An anti-foam agent makes this oil suitable for use in hydraulic governors. A wetting agent increases the oil's ability to reach and maintain a film on such highly stressed parts as cams and cam followers.

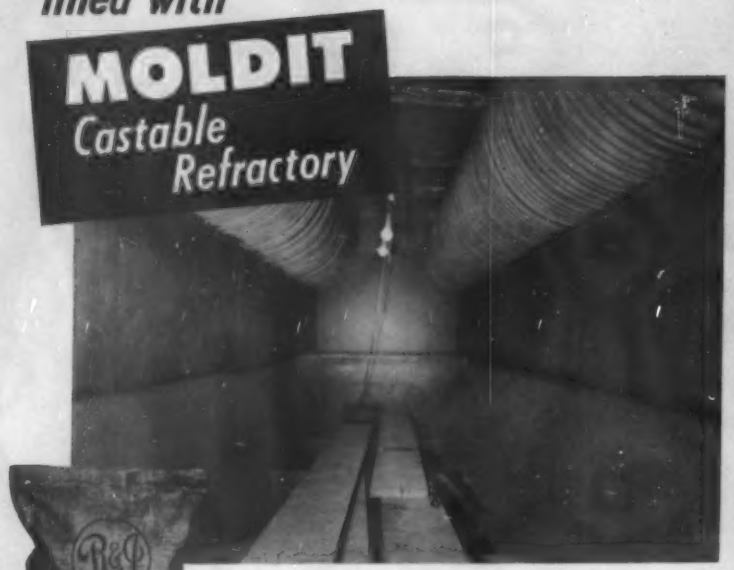
Use of STANODIESEL Oil M means this: less engine deposits, less ring and cylinder wear. Less spark plug fouling when used in gas engines. Eliminates fuel injector and pump sticking caused by deposits on the injector barrel and plunger when fuel and lubricating oil commingle.

You need to know about STANODIESEL Oil M. In the Midwest, call your nearby Standard Oil lubrication specialist. You will receive the information promptly. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD

STANDARD OIL COMPANY (Indiana)

Not a Single Repair in 12 Years on ASH HOPPERS lined with MOLDIT Castable Refractory



R & I Moldit Cements are the most successful hydraulic-setting refractory materials, easy to pour, cast or gun as monolithic linings, facings and shapes of any size.

They are compounded to best meet specific thermal and mechanical conditions from 2000° to 3000° F.

Send for catalog on Moldit and—while you're at it—get the story on Super #3000, the truly "wonder" refractory bonding mortar.

Ash hoppers of boilers take a frightful beating from abrasion and frequent quenchings of hot ash. Yet in every case where old, broken, spalled and eroded areas were filled, completely relined or "gunned" with R & I Moldit Refractory Cement, troubles ended. For example:

- Moldit linings installed in the ash hoppers of two 800,000-lb. pulverized coal boilers 12 years ago are still going strong, without a single repair—and the original cost was only a few cents per pound for Moldit, plus very little labor.
- Another power plant saved $30,000 plus considerable downtime when they repaired several ash hoppers with Moldit-D refractory linings. That was 10 years ago—and the lining is still in good condition.

These success stories are typical of Moldit's service. It will pay you to investigate why you should use Moldit-D in your ash hoppers.

REFRACTORY & INSULATION CORP.

R&I

REFRACTORY BONDING AND CASTABLE CEMENTS
INSULATING BLOCK, BLANKETS AND CEMENTS

130 WALL STREET • NEW YORK 5, N. Y.

For more data circle 520 on Post Card

information on standard specifications to which these steels are made; type, range, and accuracy of cutting to users' needs; and opportunities to save money by combining orders for these products. Joseph T. Ryerson & Son, Inc.

WATER CONDITIONING

154 If You Use Water — The varied aspects of water conditioning are detailed in this well-organized 24-pp booklet. Discusses ion exchange resins and water softening by ion exchange; reduction of alkalinity; deionization including silica removal; removal of fluorides; special applications of ion exchange resins, such as conversion of salts, removal of acids, several others. The Resinous Products Div., Rohm & Haas Co.

155 Cooling Water Treatment — The chemical treatment of industrial cooling water is discussed in this bulletin. Some aspects of cooling water problems — scale and corrosion prevention, algae and slime control — are detailed. How water treatment problems are solved by means of both open and closed cooling systems is explained. Western Chemical Co.

156 Precipitator — Twenty-pp Bulletin 2204C describes applications, principles of operation, design features, advantages, recommendations, flow diagrams, and specifications of company's precipitator, which offers an efficient means of removing impurities from a liquid by precipitation, absorption, settling, and filtration. Diagrams, photos included, as well as specifications. The Permutit Co.

LUBRICATION

157 Lithium Soap Greases — This product information bulletin details qualities and specifications of company's multipurpose lithium soap industrial greases. Advantages of multi-purpose grease use — such as prevention of lubricant misapplication, simplified maintenance procedures discussed, together with performance characteristics. Sinclair Refining Co.

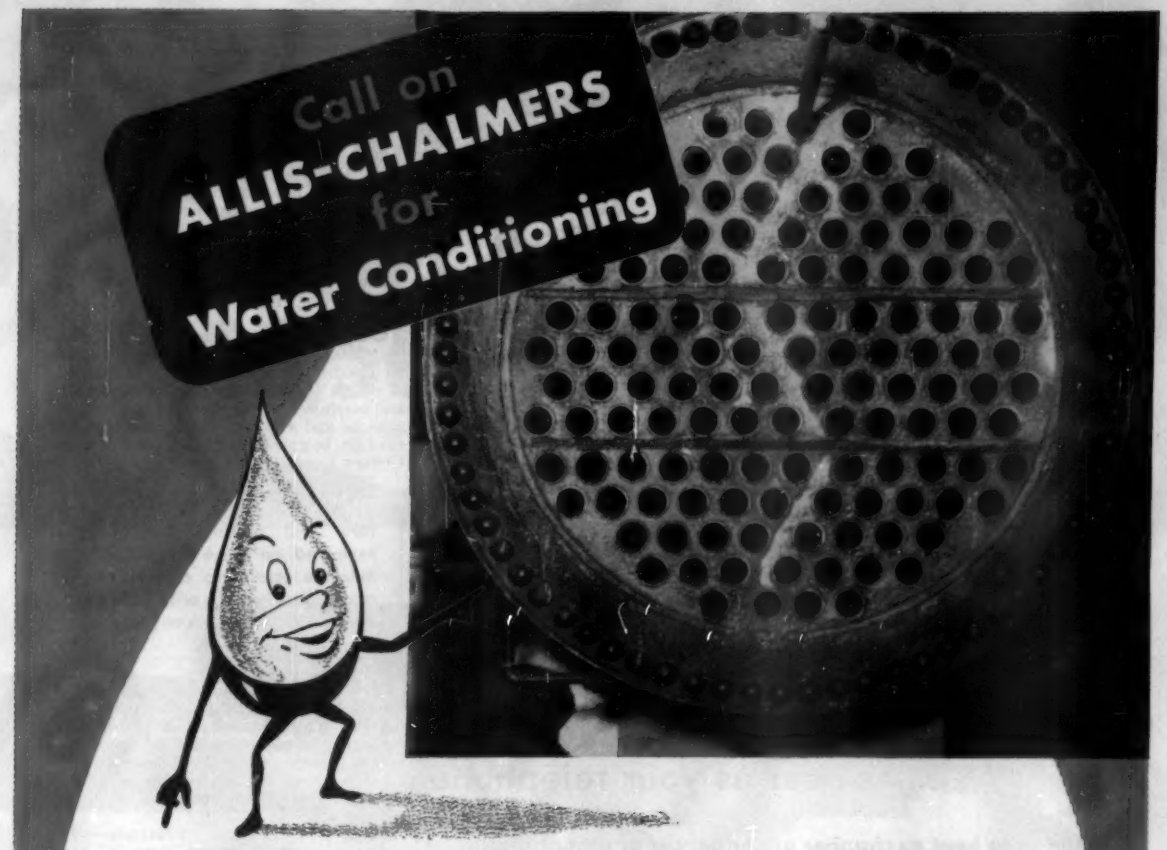
158 Automatic Grease Monkey — Bulletin A-2406 describes company's Metermatic pre-lubricated bearing design used on a-c and d-c motors to automatically regulate grease flow to bearing and afford pressure relief against over-greasing. Illustrations show how it works, and brief text stresses advantages. Reliance Electric and Engineering Co.

OTHER EQUIPMENT

159 Mechanical Draft Towers — Structural design data on the application of redwood lumber in water cooling towers of the mechanical draft, industrial type are provided in CTI Bulletin STD-102. Includes stress value, reference, allowable design stresses for redwood lumber, table showing nominal and dressed dimensions. Cooling Tower Institute.

160 Water Tube Boilers — This 12-pp bulletin describes and illustrates various types of water tube boilers and auxiliaries, including water cooled furnaces, superheaters, economizers, air preheaters, and steam washers. Also contains diagrams, tables, and boiler data. Edge Moore Iron Works, Inc., Div. of Condenser Service & Engineering Co., Inc.

161 Traveling Water Screens — Bulletin 885 describes company's traveling water screens for use in power stations and



12 MONTHS OF CONDENSER OPERATION AND . . .

Absolutely No Scale or Corrosion

Always before, every year, a heavy maintenance job. Until this year, that was the story of the horizontal ammonia condensers at the 4th Street Plant of Terminal Refrigerating and Warehousing Corp., Washington, D. C. Now Allis-Chalmers chemical treatment has provided a new picture, shown above.

You can see for yourself — there are no signs of scale or corrosion. There are scars from cleanings after previous years' operation because it used to be routine to find fairly heavy deposits partially plugging most of the tubes.

After complete analysis of both incoming water and operating conditions, Allis-Chalmers water conditioning engineers provided a recommendation that resulted in a vastly reduced maintenance problem for the plant engineer. A-C engineers also advised on efficient means for introducing the necessary chemicals into the system.

For your own water problems, it will pay to take advantage of Allis-Chalmers experience. Get more information — or a specific consultation on your problems — by calling your nearby A-C office. Or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

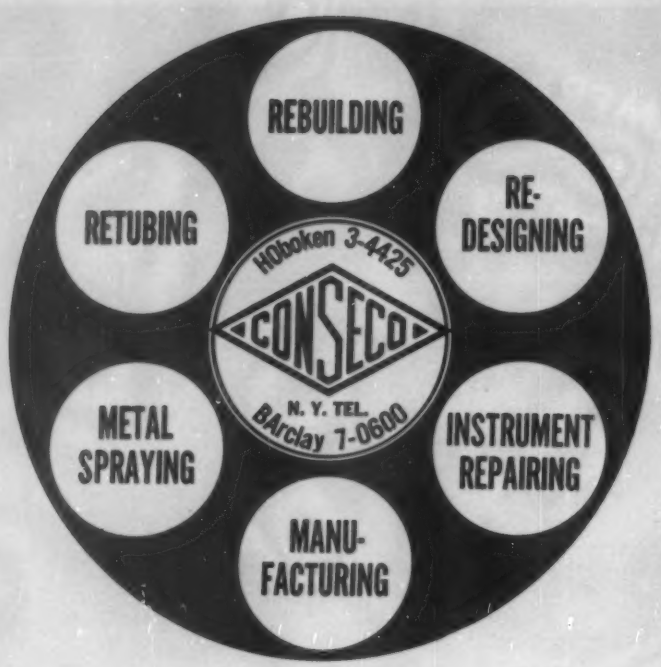
A-4822

ALLIS-CHALMERS

WATER CONDITIONING—CHEMICALS, EQUIPMENT, SERVICE—FOR OVER 25 YEARS

A-C ALLIS-CHALMERS

For more data circle 521 on Post Card



CONSECO SERVICE . . .

. . . as near as your telephone

When your heat exchanger or condenser or other tubular equipment suddenly quits . . . IT'S AN EMERGENCY . . . you spin your phone dial . . . *and in minutes, day or night, Sundays or holidays, a CONSECO REPAIR CREW is speeding to your plant.* Expert, fast, doing in hours what otherwise would take days . . . they're equipped with special tools and all the tubes, tube sheets or specialties you need, drawn from our complete stock. Yes, CONSECO SERVICE is as near as your telephone. Call our Maintenance Department.

CONDENSER SERVICE & ENGINEERING CO., INC. CONSECO

Designers and Builders of Equipment for Power, Refining, Chemical and Marine Industries

158 Observer Highway
HOBOKEN, N. J.

Equipment Designed and Built by CONSECO

Conseco and its subsidiaries design, build, and install power and processing equipment and accessories, some of which are listed here. Purchasers of Conseco equipment benefit from our maintenance division's quarter century experience in rebuilding, modernizing, and maintaining our own as well as competitors' equipment. This coordination assures easy accessibility for maintenance and low operating cost. Send for bulletins covering equipment in which you are interested.

HEAT EXCHANGERS
CONDENSERS
EVAPORATORS
STEAM JET AIR EJECTORS
STEAM GENERATORS
PRESSURE VESSELS
CENTRIFUGES
FILTERS and STRAINERS
PUMPS, INSTRUMENTS, SPECIALTIES

For more data circle 522 on Post Card

water treatment plants. Demonstrates how these screens remove destructive floating debris and suspended matter from water by straining them from the influent channel. A drawing, specifications and data form included. The Jeffrey Mfg. Co.

162 Vibro-Isolators — Bulletin K3A gives latest data on stopping vibration, shock and noise transmission by steel spring machinery mountings. Typical case-histories, with installation photos, tell how vibro-isolators solved a variety of vibration problems. Tables giving capacities and characteristics are furnished. The Korfund Co., Inc.

163 Protection From Smog — This 6-pp booklet recommends a well engineered air distribution system, adequate removal of coarse particles and fine aerosol mists, and activated carbon filtration to eliminate gaseous and vaporous impurities from intake air, to guard against hazards of smog. Connor Engineering Corp.

New and revised publications reviewed on these pages offer help on operating and maintenance problems. To order, use the Reader Service Cards on page 27.

164 High Pressure Equipment — Catalog 2055, 28-pp, describes company's line of high pressure valves, adaptors, reactors, autoclaves, thermo-couplings, gages, fittings and tubing. Includes photos of items, diagrams, and dimensional data. High Pressure Equipment Co., Inc.

165 On Crawler Tractors — The technical and operating story of company's new HD-16 tractor is told in 8-pp Form MS-662. Provides a pictorial review of the design, engineering, and operating advancements. Includes specifications and information on operator comforts. Construction Machinery Div., Allis-Chalmers Mfg. Co.

166 Fire Extinguishing Systems — Information on Foamite Airform fire extinguishing equipment for combatting flammable liquid fires is offered in this 36-pp engineering data book. Attractively illustrated, this booklet contains useful facts on Foamite Airfoam fixed fire protection systems, portable, semi-portable equipment. American La-France Corp.

168 Unit Air Conditioning — Diaflo unit conditioners for summer cooling and winter heating in multi-room structures are described in Bulletin 8227. Operation construction and design features are described and illustrated. Also provided are installation drawings giving dimensions. American Blower Corp.

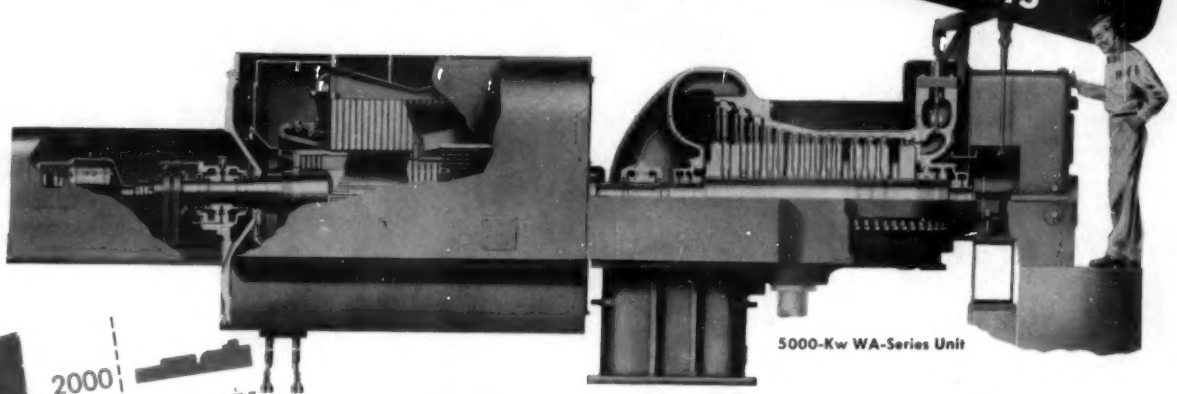
169 Welding Equipment — Sixteen pp Catalog 2350 describes and illustrates equipment for Aircomatic (an inert-gas-shielded metal arc welding process) welding. Manual and automatic units as well as accessory apparatus and welding wire are covered. Air Reduction Sales Co.

170 Treatment For Burns — Bulletin 0402-3 describes company's Foille burn kit for immediate treatment of all types of burns. Points out advantages of the aerosol spray technique for quick application of the Foille antiseptic, to control pain, mitigate shock, preserve tissue. Mine Safety Appliances Co.

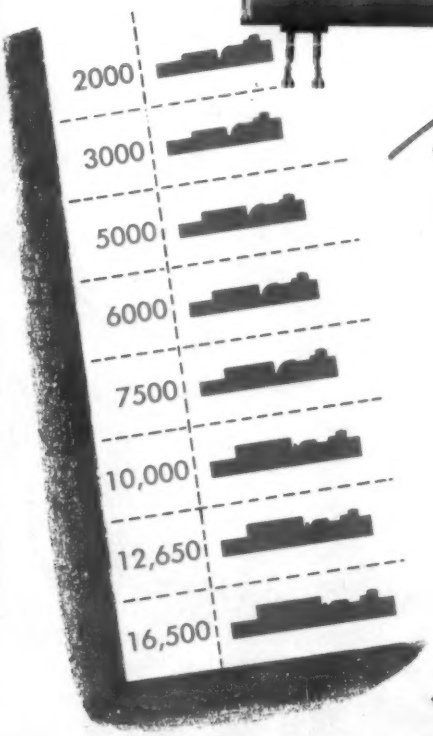
Now

WA-Series Extended To 16,500 Kw

WA-Series STEAM TURBINE GENERATOR UNITS



5000-Kw WA-Series Unit



Modern, Compact Units meet wider plant needs

Now you can get WA-Series steam turbine-generator units in new, higher ratings. Already operating across the country in NEMA ratings from 2000 to 7500 kw, these completely modern units are now available in AIEE-ASME preferred ratings to and including 16,500 kw.

WA-Series steam turbine-generator units provide power only or power as a by-product of process steam. They are attractive, compact units that have many of the "big turbine" features for which Allis-Chalmers is famous.

For example, the accurate, reliable centrifugal speed governor is the same type used in large Allis-Chalmers steam turbines. Steam seals are the same trouble-free labyrinth type used in turbines up to 300,000 kw.

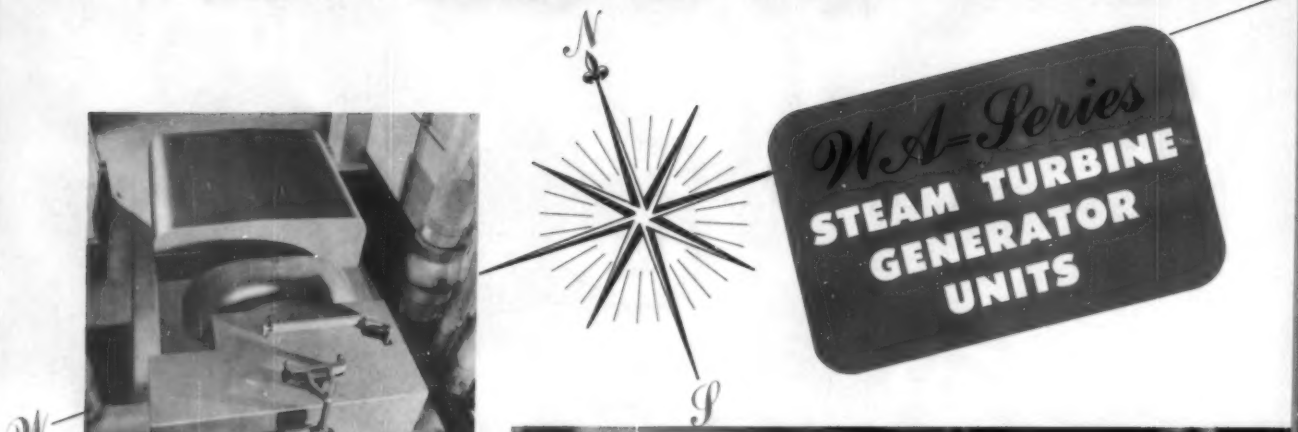
For information on application of these modern, economical generating units, turn the page.

A-4810

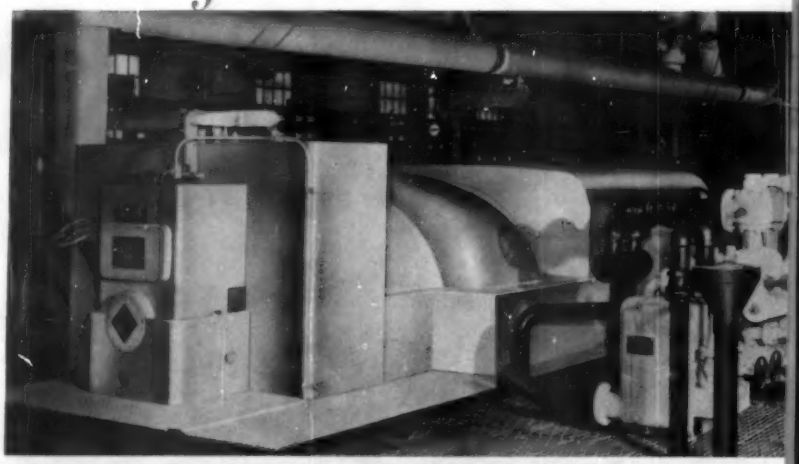
A-C ALLIS-CHALMERS

ALLIS-CHALMERS

For Modern Power

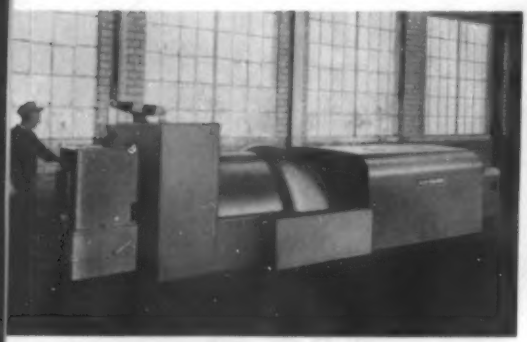


MANUFACTURING PLANT in Wisconsin uses this 7500-kw automatic extraction condensing unit in its power house. WA-Series unit generates power as by-product of process steam.



MINING OPERATION in Southwest gets power from a 5000-kw condensing unit. Waste heat from reverberatory furnaces is used for generating steam.

PAPER MILL in Wisconsin uses this 5000-kw non-condensing WA-Series unit to obtain both power and process steam for paper manufacturing. Photo at right shows generator end of unit.



UTILITY SERVICE in Ohio is provided by 3000-kw condensing WA-Series steam turbine generating unit.

ALLIS-

Plants Everywhere

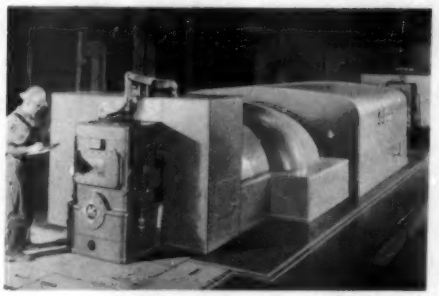
● Installations throughout the country are proving the low installation and operating costs of modern WA-Series steam turbine-generator units.

Maximum simplicity is assured by three-bearing construction. A bracket-bearing, housing type air-cooled generator is used for smaller units. A hydrogen-cooled generator is used for 16,500-kw units. Basic engineering features include labyrinth steam seals throughout, removable external glands, high chrome alloy steel buckets and nozzles and a time-proved governing system.

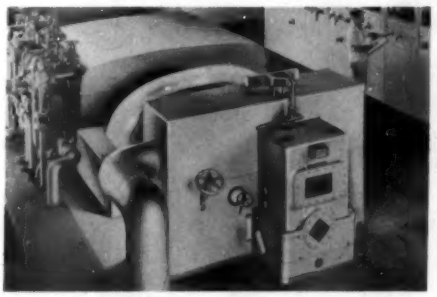
Installation is simplified because WA-Series units are factory assembled, and shipped on a single flatcar. Turbine and generator rotors are individually locked securely in place. All manufacturing and testing takes place in a single plant.

Foundation cost is reduced because oil piping and generator air coolers are above the floor line.

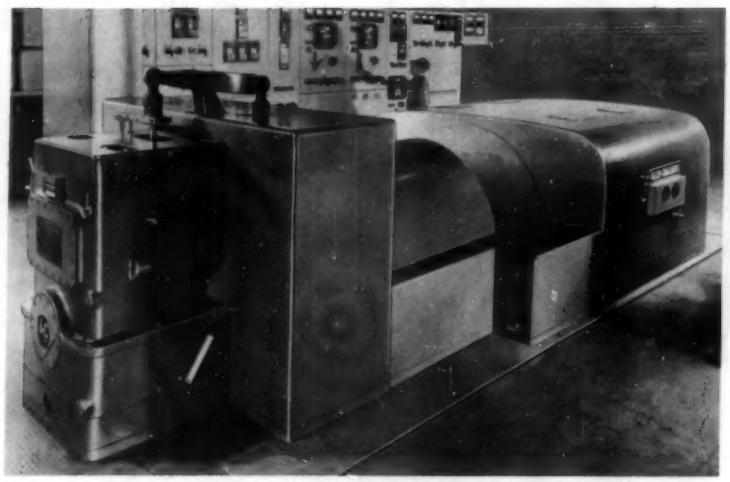
To get more facts on these economical units, call the nearest A-C district office or write Allis-Chalmers, Milwaukee 1, Wisconsin for Bulletin 03B7654.



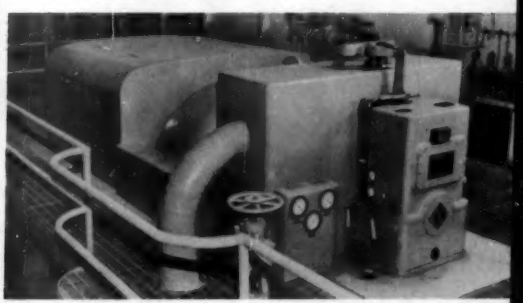
CHEMICAL OPERATION in Illinois uses two 5000-kw automatic extraction condensing units which generate power as by-product of process steam needs.



UTILITY in Florida uses two 5000-kw condensing WA-Series units to supply power for consumer needs.



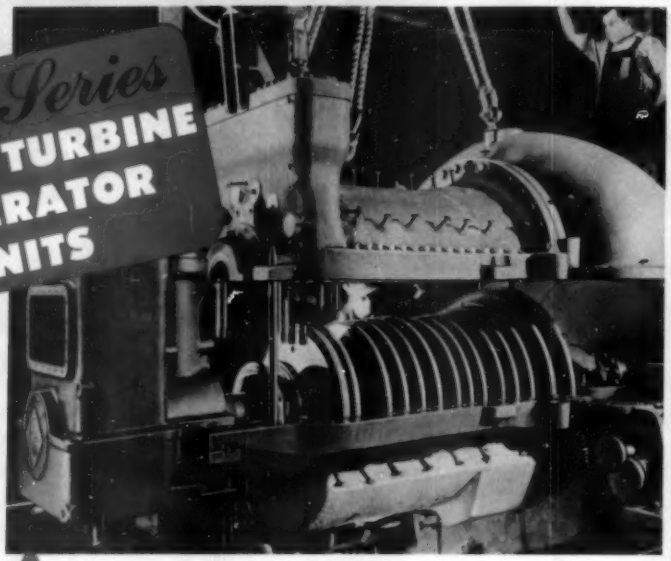
GRAIN PROCESSING in Wisconsin requires power and vast quantities of process steam 24 hours a day, 7 days a week. A 2500-kw non-condensing unit supplies power as by-product from process steam.



CEMENT PLANT in Kentucky obtains electric power from a 5000-kw condensing WA-Series unit. Steam is produced with waste heat from kilns.

CHALMERS

A-C ALLIS-CHALMERS

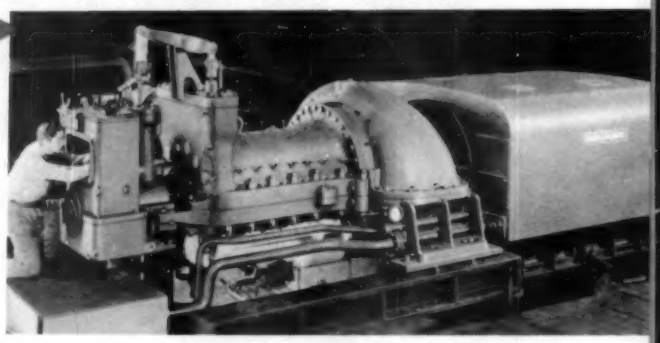


Above: Precision balanced turbine rotor is lowered into casing during manufacture of a WA-Series steam turbine generator unit. One example of the quality designed into these units: all wheels have durable chrome alloy steel buckets.

Next step in assembly is addition of upper half of the turbine casing. WA-Series units provide the benefits of more than 50 years of Allis-Chalmers experience in designing and manufacturing steam turbine generating equipment.

Precision Built
For Fast Installation

Assembled 3-bearing unit—complete with housing type generator — is factory tested. Both oil piping and generator gas coolers are above the floor line, simplifying installation and service.



An entire WA-Series unit—pretested and insulated—is loaded on a single flatcar for shipment. Both turbine and generator are shipped with their rotors locked securely in place. Below, a 7500-kw unit in transit.

ALLIS-CHALMERS

Milwaukee 1, Wisconsin

exhibits like this . . . at the

CHICAGO EXPOSITION OF POWER & MECHANICAL ENGINEERING

WHERE? . . . Only minutes away from the ASME Meetings at Chicago's COLISEUM . . . one floor with information-packed exhibits — a minimum of walking to get a maximum of facts, helpful tips — a complete picture of Power and Mechanical Engineering TODAY!

WHEN? . . . November 14-18, 1955

WHY? . . . This special show is in conjunction with the 75TH ANNIVERSARY MEETING OF THE ASME. The significant theme of these sessions is "THE ENGINEER AND THE WORLD OF COMMERCE AND INDUSTRY." Subjects of vital importance to *your* field of interest will be covered. At the EXPOSITION, you'll see the newest, most advanced power equipment . . . manufacturers' exhibits that will show hundreds of new techniques to improve productivity and economy, and to utilize all types of power more effectively.

Plan now to attend the

CHICAGO EXPOSITION OF POWER & MECHANICAL ENGINEERING

(Under the auspices of the ASME, and in conjunction with its 75th ANNIVERSARY Meeting)

For advance registration, write The Management:

INTERNATIONAL EXPOSITION COMPANY • 480 Lexington Avenue • New York 17, N. Y.

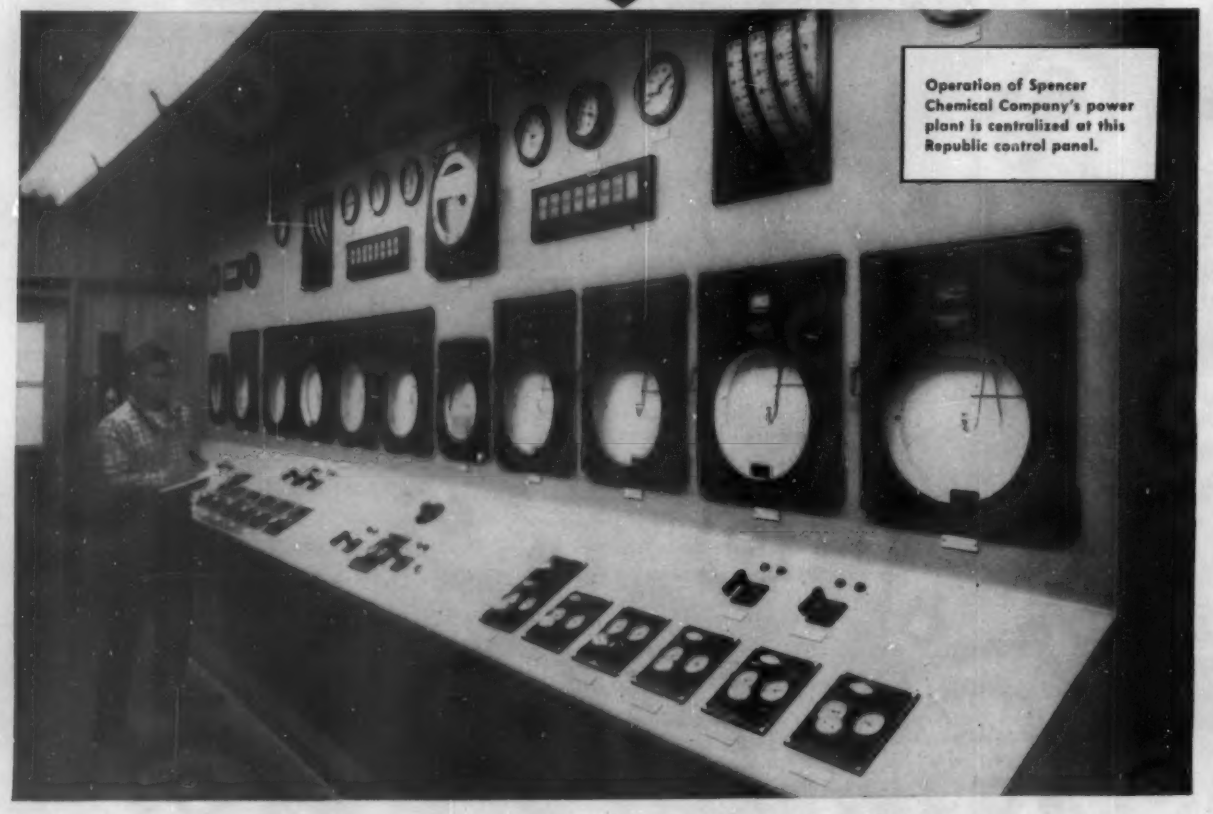
Automatically Controls Outdoor Steam Plant

FOR FAST LOAD CHANGES

REPUBLIC Combustion Control System at New Texas Chemical Plant Automatically Prevents Flame-Outs and Over-Firing on Wide Load Swings, Enables Boilers to Meet Sudden Steam Demands Smoothly and Safely

Extremely large and fast load changes make combustion efficiency only part of the combustion control job at Spencer Chemical Company's new Orange Texas polyethylene plant. The control system operates two gas fired 60,000 lbs. per hour boilers in the plant for fast response to load changes without over-firing or losing ignition on wide load swings.

To prevent over-firing when there is a sudden demand for more steam, a gas



Operation of Spencer Chemical Company's power plant is centralized at this Republic control panel.

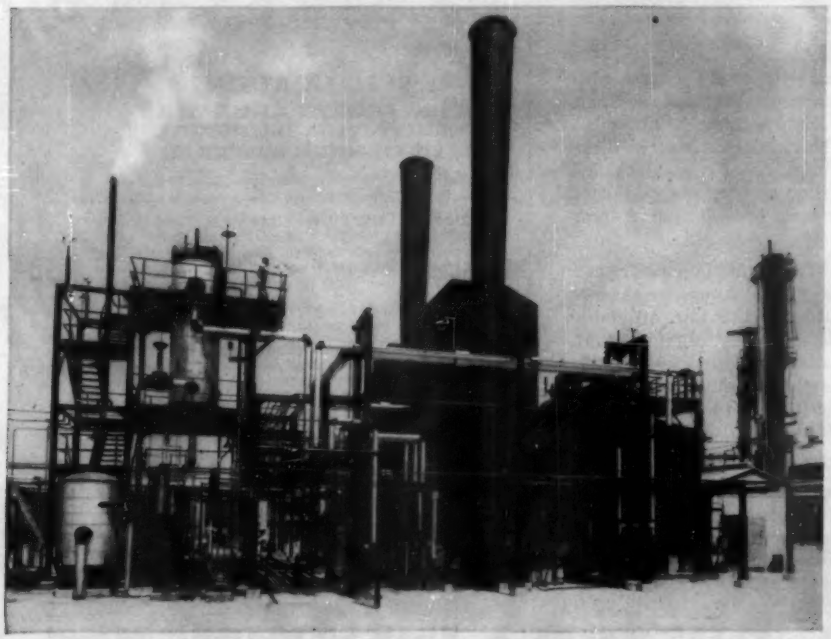
safety regulator keeps the fuel valve in step as draft fans increase speed. By compensating for the unequal speed of response of the two boiler auxiliaries, the control system maintains proper conditions *even while loads are changing.* If steam demand falls below minimum steam conditions, a minimum gas pressure is maintained automatically at the burners, regardless of the number in service, to prevent flame-outs. In addition to safer operation, these features also mean continuous combustion efficiency for extra fuel savings.

When your problem is combustion control—for a small power plant or a central station—it will pay you to contact Republic. At your service is an experienced engineering staff that can design the control system that exactly meets your needs—specialized as they may be. This combination of expert design and modern Republic equipment can assure you of dependable, efficient control of your power plant.

REPUBLIC
Automatic COMBUSTION CONTROLS
(pneumatic or electronic)

- ★ **FOR ALL SIZES AND TYPES OF BOILERS**
- ★ **FOR ALL LOAD CONDITIONS**
- ★ **FOR ALL METHODS OF FUEL FIRING**
- ★ **FOR ANY ARRANGEMENT OF DRAFT**

Write for details

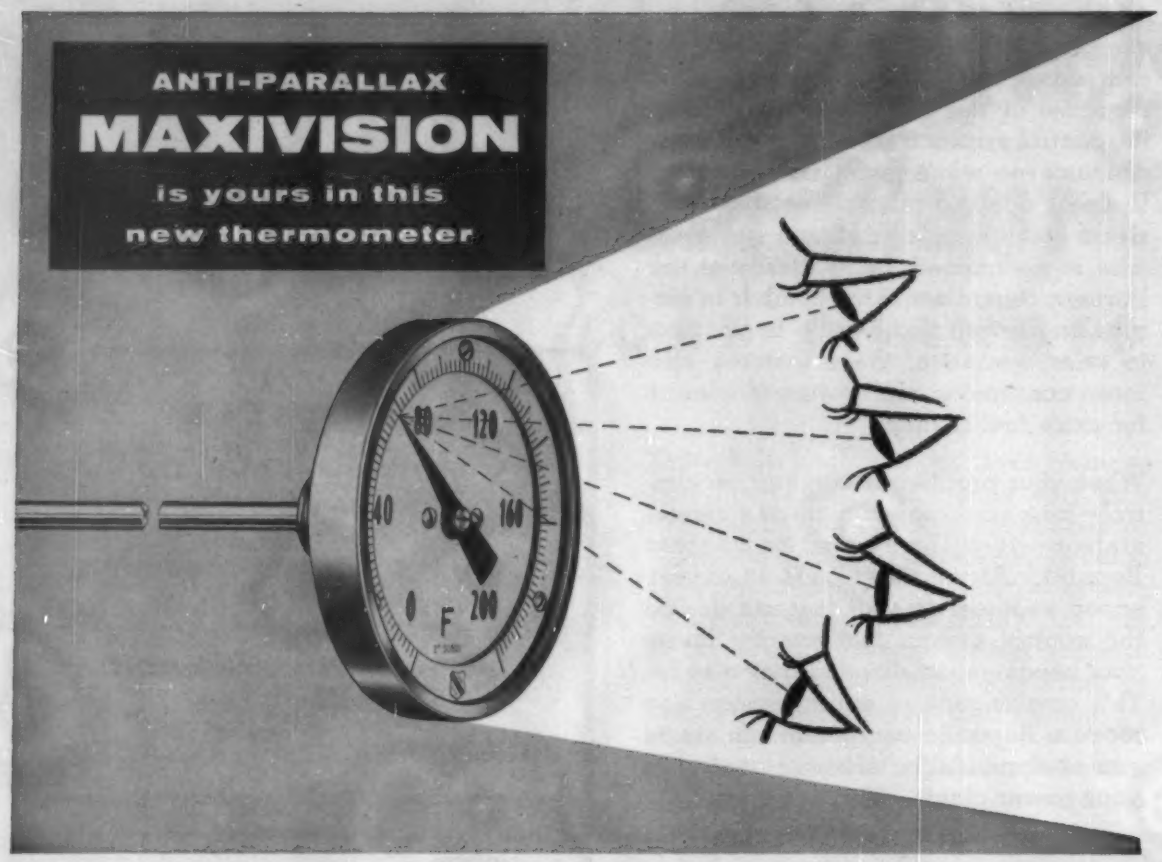


THE ENTIRE POWER PLANT,

except for the control panel is outdoors. Panel board is housed in sheet metal building at right. The two 60,000 lbs. per hour gas fired boilers, operating at 415 psi and 750°F., furnish steam to compressors used in converting ethylene gas into polyethylene. This is new miracle plastic that is used for products ranging from "squeeze" bottles to electrical insulation.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

For more data circle 525 on Post Card



Now you can read temperatures *right at the process* with the same ease, accuracy and economy as pressure readings. The Anti-Parallax Maxivision Dial on this new all stainless steel American Bi-Metal Thermometer assures these important advantages. The large, easy-to-read black figures and graduations are carried on a raised ring set close to the glass, with pointer at the same level. Parallax error is practically eliminated.

With this new thermometer in service, field operators can eliminate frequent trips to the control house to observe process changes. Indoors or outdoors, this fine, all stainless steel American instrument is truly climate-proof. Because the case is only 3" in diameter, the thermometer fits where space is limited. Ample clearance behind the case makes installation easy and fast with a small wrench. Read the specification highlights, then get full details about this new high-accuracy American Bi-Metal Thermometer.

PHONE your Industrial Supply Distributor for prompt attention to your needs. He is always ready to help keep your production going by making fast delivery from local stocks.

SPECIFICATIONS

New AMERICAN ALL-STAINLESS STEEL BI-METAL THERMOMETER with ANTI-PARALLAX MAXIVISION DIAL

Dial: Exclusive anti-parallax Maxivision dial, with scale approximately 6" long. Pointer set at same level as scale.

Climate-Proof Case: All stainless steel. 3" diameter. Threaded bezel. Selected clear, extra-heavy cover glass. Heat-resistant gaskets between glass and case seal the thermometer against rain, frost, sand, dust, fumes—climate-proof.

Temperature Ranges: From minus 80° to plus 1000° F. Accuracy within 1% of range.

Low-Mass Bi-Metal Coil: Welded to stem plug. Accurately centered in stem. Non-freezing, non-corrosive silicone fluid on coil dampens vibration, accelerates heat transfer, speeds response; does not gum, resists capillary action.

Pointer: Index type. Easily accessible from front of dial for positive adjustment over entire range. Pointer shaft guided by friction-free bearings.

Stem: 18-8 stainless steel, mirror polished. All joints welded. Resists corrosion. Provides strong, rigid and tight closure against process pressures. Lengths: 2½" to 24".

Connection: Fixed, ½" N. P. T.

Separable Sockets: Available for use in closed systems or where measured medium is corrosive to the stainless steel stem. Fit over all standard stem lengths except 2½".

AMERICAN INDUSTRIAL INSTRUMENTS

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'ASHCROFT' GAUGES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, *Stratford, Conn.* HANCOCK VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Oklahoma.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

For more data circle 526 on Post Card

There's Steam Economy in FLEXIBILITY

Above, six Erie City Keystones meet a variable heating and processing steam load at the Ohio Masonic Home in Springfield, Ohio

JOSEPH BRESLOVE & ASSOCIATES
CONSULTING ENGINEERS
CLEVELAND, OHIO

Picture the boiler operating advantages of multiple Erie City Keystone Steam Generators in your plant. Multiple "Keystones" permit high efficiency operation. During periods of low loads, take one or more units off the line—for high loads, the rapid steaming "Keystones" respond quickly to increased requirements.
Compact, completely factory assembled and Factory Fire Tested "Keystones" fit into any plant's variable steam needs.
There is nothing to assemble in the field.
Need steam at some remote plant location indoors or outdoors? Investigate the use of one or more "Keystones." Bulletin SB-51 describes the fully automatically controlled Keystone.

ERIE CITY
115 Years in Steam Generators

You can depend on Erie City for sound engineering

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

For more data circle 527 on Post Card

EQUIPMENT NEWS

Described on these pages are new and improved products. Use Reader Service Cards on pages 117–118 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

1—SILENCER cuts down noise from pressure reduction

Noise caused by pressure reduction operations need not be a problem in natural gas distribution and steam systems, says manufacturer of the PRS Silencer; by means of this silencer, pipe ring and resultant noise radiation within the regulator system and over the surrounding area can be eliminated. The silencer is installed in the downstream piping near the reduction valve, to stop the noise at its source. The unit is designed in accordance with applicable code requirements for piping and pressure vessels, it is noted, and it does not restrict flow of gas or steam in the line. Pressure drop through the silencer is claimed no greater than through the equivalent length of pipe. Burgess-Manning Co.

2—REVERSIBLE FAN is double ring type, three sizes

This double ring reversible fan is designed for ventilating jobs requiring intake during some periods and exhaust during others. It consists of an aluminum alloy reversible propeller and two curved orifices welded face-to-face. The fan is available in direct connected, belt drive, pulley drive, and extension shaft models and may be had in 28, 36 and 44 in. diameters. Hartzell Propeller Fan Co.

3—MOTOR MOUNT acts as "harness for horsepower"

Designed to provide a quick and dependable way of harnessing fractional horsepower motors and small gasoline engines, Universal Motor Mount Model 20 is available in three sizes. Pulleys can be quickly aligned, and belt tension can be adjusted, manufacturer points out,

or tools can be attached for direct drive. It eliminates necessity of locating and drilling holes in work benches. Mount permits two-way movement of motor, and motor can be used to pump water, saw wood, operate paint sprayers, sanders, tool sharpeners, air compressors, battery chargers, power tools. Available in slate gray and maroon finish, the mount has all-steel construction, yet is lightweight and sturdy. Arco Mfg. Co.

4—AUTOMATIC STOP METERS handle the higher flows

Two new Auto-Stop Meters are available with double-trip automatic stop valves. Automatic deliveries of water, syrups, oils, solvents and other liquids are accomplished with accurate cut-off and minimum hydraulic hammer even with high flow rates, says manufacturer; the quantity desired is set by pushing buttons and the meter shuts off the flow when the exact quantity is delivered.

The bronze meters are 1½ and 2 in. in size (10 to 100 gpm and 16 to 160 gpm flow rates). When applied to low viscosity liquids, such as water, the valve is furnished with a double-trip or cushioned-stop mechanism which acts to slow down the fast moving stream an instant before it shuts off the flow. Low loss of head is another feature announced for this automatic stop valve. The design affords straighter flow to eliminate turbulence, it is noted, and the valve is easily opened even against high line pressure. For viscous liquids at low rates of flow where there is no danger of hydraulic hammer, the automatic stop valve is offered with single-trip mechanism. Neptune Meter Co.

5—AIR DIFFUSER designed for draftless air conditioning

Modular Multi-Vent has been developed as a competitively-priced version of company's Multi-Vent air diffusing principle for providing draftless air conditioning and uniform temperature control. Its advantages are not restricted to air cooling, says company; they apply equally well to heating and ventilating systems. Modular Multi-Vent employs a perforated ceiling panel to introduce air vertically, and at low velocity, into a room or working area. These perforations reduce the high velocity of air in the duct from 1000 to 1500 fpm to 40 to 50 fpm as it leaves the panel, it is explained, just as the perforated head of a sprinkling hand delivers the same amount of water as a direct spout, but in a gentle and more widespread flow.

This air diffuser can be concealed from view, it is pointed out; it doesn't interfere with light fixtures and it permits walls, shelves and partitions to be moved freely. Also, dirt marks and smudges are claimed to be eliminated because air leaving the diffuser moves vertically, away from the ceiling. The panels may be had for metal pan, plaster and acoustic tile ceilings, as well as for exposed duct applications. The units run in price from $5.75 up. Pyle-National Co.

6—INTERNAL TUBE CUTTER is small, push-type tool

An adaptation of this company's internal tube cutter, this new push-type cutter is being produced without a motor or operating lever to operate the cutters. It may be used with an air or electric motor, and is small enough to be carried in a tool box. Action of the cutting blades is produced by pushing the cutter into the tube which automatically opens the double cutter blades. Designed to be used chiefly as a maintenance tool, this push-type internal tube cutter is suggested for smaller plant operation where the speed and power of the larger internal tube cutter aren't required. In application, the new cutter is said to work best on non-ferrous tubes, and is reported particularly useful in plants where it is often necessary to replace worn, small diameter tubes ranging from ⅝ to 1 in. OD. The Airetool Mfg. Co.

7—INDICATING INSTRUMENTS with scales only 5-in. high

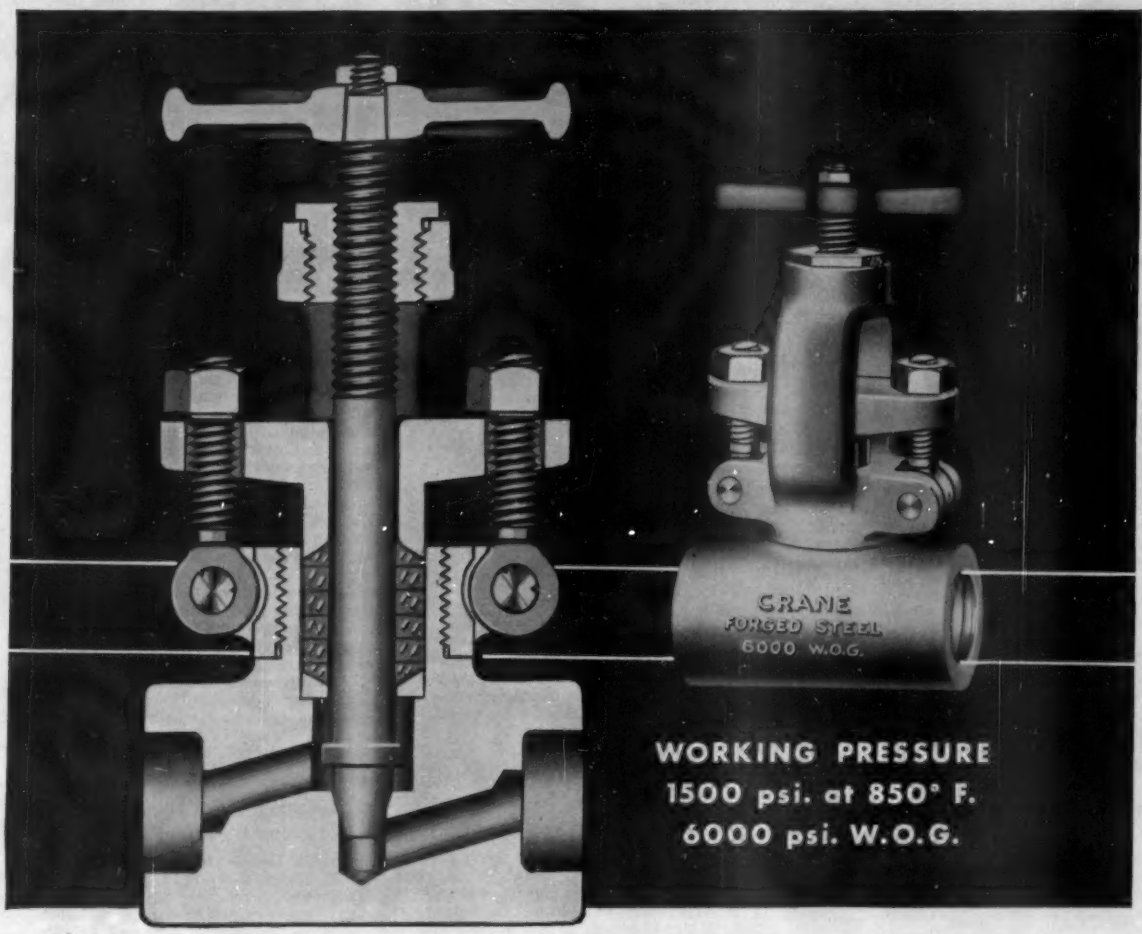
The V5 Series of small-size receivers and draft, pressure and temperature gages have scales 5 in. high, yet because of their design and illumination are claimed easy to read, even from a distance. Each gage or receiver is an in-

dependent, self-contained unit and may be grouped together with as many as eight other units in a single case, or mounted individually. Units may be removed without disturbing others in the case. These units may be used as self-contained measuring instruments — or as receivers for pneumatic transmitters and controllers. The line includes a differential pressure for furnace draft that makes a direct measurement of draft, vacuum and low-positive pressures. Bulletin 806 describes the V5 line. Republic Flow Meters Co.

8—SAFETY VALVE for high pressure service

Designed for high pressure, high capacity steam generating units, Style HC Safety Valves are said to reduce number of valves required, and enable user to valve a generating unit at minimum cost and with assured safety. Valves are designed for pressures to 3,000 lb, temperatures to 1050 F, with flanged outlet and welded or flanged inlet, in sizes from 2 to 4 in. To maintain a constant popping point, design has fea-

Now Available



New Crane Forged Steel Instrument Valves

Been looking for an exceptionally rugged, compact, and low-priced stop valve for your small hydraulic or high-pressure, high-temperature instrument lines?

Crane has developed it—sizes ¼", ⅜" and ½", in both screwed and socket-welded patterns. It's the all-new Crane Forged Steel Instrument Valve, and you can specify it now for immediate delivery.

Will Handle Many Services

Note closely the over-all design and construction shown above of this new Crane valve. Oversized stuffing box—heavy-duty Crane Exelloy stem with integral disc—bolted gland—swinging gland eye bolts—outside screw and yoke construction—all add up to the high performance and low maintenance you want in a valve for your instrument panels, orifice meters, bypass and gauge lines, regulator leads, and other hydraulic and high pressure/temperature lines.

Literature on Request

These rugged, low-cost stop valves are built for 1500 psi. at 850° and 6000 psi. W.O.G. Construction and materials are job-engineered by Crane experts—backed by a century of quality manufacturing, matchless experience. You'll want complete information on the all-new Crane Forged Steel Instrument Valves. Contact your Crane Representative, or write to Crane Co., General offices, Chicago 5, Illinois—Branches and Wholesalers serving all industrial areas.

for the THRIFTY BUYER

CRANE CO.

VALVES • FITTINGS • PIPE
KITCHENS • PLUMBING • HEATING

CRANE'S FIRST CENTURY...1855-1955

For more data circle 528 on Post Card

tures which maintain minimum changes in spring load. For superheater service a cooling spool and spindle with high thermal expansion coefficient provides proportional thermal compensation.

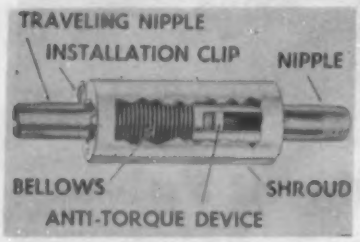
Two adjusting rings control reactive and expansive forces of flowing steam to produce full disc-lift, allowing valve capacity to be governed by nozzle alone. Rings provide predictable blowdown control under all operating conditions, it is said; any strains of seating surface are blocked by a heavy section between seating surface and seal weld. Catalog 400-HC gives more data. Crosby Steam Gage & Valve Co.

9—GAS BURNERS, six models are economically priced

According to manufacturer, these burners offer easily set accurate air-gas ratios, high efficiency and high quality controls and are priced 30 to 40 per cent lower than company's previous models. In the new line are six gas and gas/oil burners in capacities from 720,000 to 8,600,000 Btu. The burners can be used for gas alone; for light oil (No. 2 grade) and gas; and a combination of heavy oil (No. 5 grade) and gas. Secondary air in these burners is furnished by the burner, it is noted, the burner does not have to depend on stack draft. Air is controlled through the damper modulating between high and low fire. Cleaver-Brooks Co.

10—EXPANSION COMPENSATOR for vertical heat-riser lines

The Model H Flexon Expansion Compensator has a two-ply stainless steel bellows as the pressure carrier, and is enclosed in a steel housing with steel



pipe nipples on both ends. An anti-torque device is built in to protect bellows element during installation. This unit is so designed as to enable placing it in any wall without access panels or special construction. Available in NPT sizes of ¾ to 3 in., the compensator takes pressures up to 150 psi and absorbs line expansion of 1½ in. Installation in vertical risers is easy, it is claimed, due to the small size and light weight of the compensator. Male NPT nipples are standard, with ground joint unions or weld ends also available. Flexonics Corp.

11—ADJUSTABLE GROWLER tests 1- to 18-in. diam armatures

Built with adjustable jaws (2½-in. face length) the Type B-1-M Growler is so constructed that no matter what the setting of the jaw opening may be, the armature is suspended above the center of the jaws, it is explained, thus preventing tipping. A meter connected to a secondary winding on the growler shows any change in the magnetic flux of the growler. This method is claimed more sensitive than an ammeter in the line, and to give a large meter deflection in most cases of defective coils. The Martindale Electric Co.

12—DEFLECTION INDICATOR for shafted machinery

Operating on a balanced bridge principle, this deflection indicator consists of two compact inductor coil pickup units which operate on a 60-cycle, 110-v power source and control assembly. It has no electronic tubes. When operating on a rotating machine, the two external series-connected pickup coils of matched

impedance are mounted on opposite sides of the shaft with equal gaps between each coil and the shaft.

These coils form half the bridge circuit; the power source the other half. A lead from the midpoint of the coils is connected through a rectifier to the midpoint of the power source. So long as the air gaps remain constant, the bridge circuit is balanced and no current flows. If, however, a shaft deflection or vibration occurs beyond the limit present on the device, the variation of the air gap will unbalance the impedances, it is explained, and cause current to flow. A signal is sent to a magnetic amplifier and the operator is warned by a light on the control cabinet or by an annunciator. The control unit can be located where convenient. A time delay serves to prevent false warnings caused by vibration of short duration. Applications for the indicator include sewage and pipeline pumps, compressors, other shafted units. Allis-Chalmers Mfg. Co.

13—SLUICE GATE is of bottom closure construction

The HY-Q is a flush bottom closure sluice gate designed to allow more flow, yet assure closure against flow in either direction. In this gate, the frame has been lowered so that the opening is flush with adjacent chamber floors or with the natural bottom floorline. The HY-Q Gate seats flush with the invert. Company points out that it eliminates the barrier which must be built for many gates to seat against or the deep pocket in which wedges must descend. Of cast iron bronze-mounted construction, this gate is secured in closed position by heavy bronze wedges on top and sides.

The HY-Q Gate carries on the bottom of the gate disc a heavy strip of Neoprene — when gate is closed, the Neoprene flexes and gives a cushioning closing seal which compresses on the stop bar. According to manufacturer, this design provides benefits of narrow and broadface contacts on the sealing surface; it can be adapted to both unseating and seating pressure conditions and to all types and sizes of cast iron bronze-mounted sluice gates. Several advantages are cited for the flush bottom closure: smoother flow, because there is less turbulence at the bottom where head is greatest; no barrier to accumulate silt and trash; improved sluicing action; and complete drainage of the outflowing channel. Rodney Hunt Machine Co.

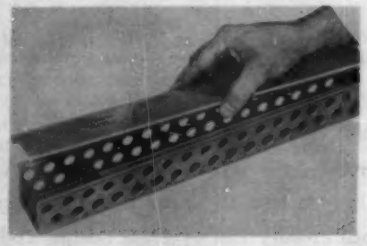
14—METERING PUMP is solenoid-clutch operated unit

For metering to a flow, UMC Pump is a positive displacement unit actuated by a solenoid operated single revolution clutch. This arrangement permits one stroke of the pump plunger in response to an electric signal which may be timed to effect a feed rate to the main flow line at regularly timed intervals, it is explained. Electrical impulses can originate from a mechanical flow meter, differential meter, gravimetric meter, or program timer.

Though designed primarily for metering and proportioning of additives and odorants to fuel and natural gas lines, this pump is also suggested for the addition of boiler feed compounds and use in chemical and food processing. Its outstanding features are announced as low unit and operating cost, positive operation and immediate availability. The UMC Pump comes in maximum capacities from 0.10 gph to 20 gph per feed. Single feed is standard, but two-feed units are available — operating pressures to 5000 psi. Hills-McCanna Co.

15—WIRING DUCT, vinyl plastic, can be installed quickly

This rigid Geon vinyl plastic wiring duct is designed to hold, protect and distribute a harness — and to eliminate lacing. The wiring duct can be installed three times as fast as lace and bundle wiring, it is announced, and six to eight times as fast as flat wiring with clips. Also, unlacing or relacing is claimed not



necessary when making a wiring change in a control panel using the vinyl duct.

The wires are simply laid in the duct and distributed through holes punched uniformly in the side. The plastic cover snaps on or off. Holes for mounting are spaced in the bottom of the duct at 3-in. intervals. The duct is made from B. F. Goodrich Co.'s Geon vinyl resin, a material, which offers high impact strength, bends or forms to any shape, yet may be cut with bandsaw, hacksaw, tinsnips or pocketknife. It is said to resist the effects of acids, alkalis, greases, to be non-combustible and have excel-

NEW DIMENSIONS IN CENTRALIZED CONTROL

Two story benchboard controls giant multiple fuel cyclone fired boiler!

The 125,000 KW extension to Raritan River Plant of Jersey Central Power and Light Company can be operated entirely from the compact benchboard shown here. This console, built by Hays and designed by Burns and Roe, Inc., consolidates the necessary control stations and miniature indicators in a small space yet provides easy accessibility for servicing.

In addition, this new design two story benchboard reduces costs three ways:

Lower operating costs—fewer men operate more equipment.

Lower installation costs—entire board fabricated by Hays. Minimum field piping and wiring.

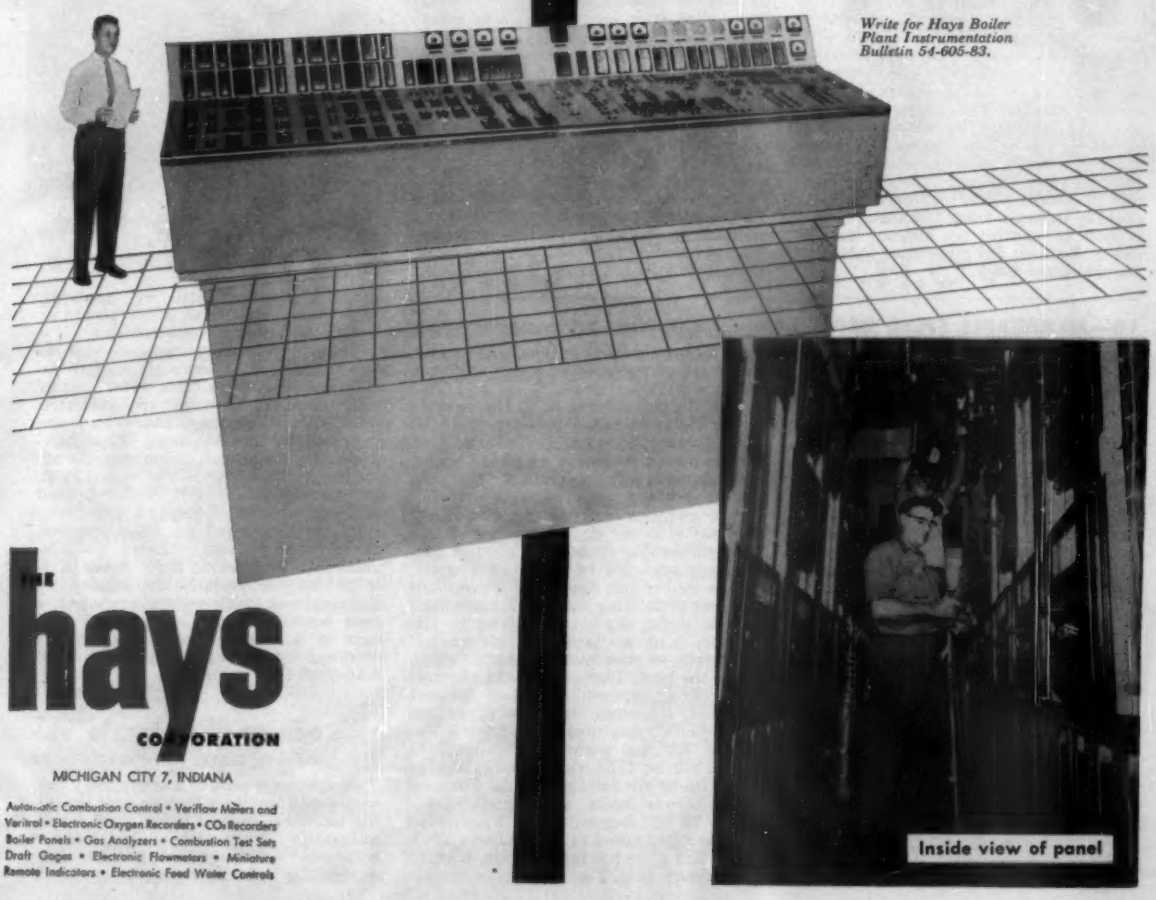
Lower maintenance costs—easy accessibility for maintenance from *inside* the panel (photo below).

Four cyclone furnaces are employed by the pressurized steam generator to deliver 900,000 lbs/hr. of main steam at 2,000 psig, 1050° F. and 740,000 lbs/hr. of reheat steam at 430 psig, 1000° F. The boiler is designed to burn coal and gas in any combination in all cyclones.

A Hays electrically operated combustion control system was selected by Jersey Central. Its electric operation eliminates the need for expensive compressors and dryers and allows maximum flexibility in central control location. Provision has been made in the system for future addition of oil as a third fuel with no loss in flexibility.

Hays paramagnetic type O_2 analyzers with new design sampling systems and electronic recorders are used for oxygen compensation of the control system.

Write for Hays Boiler Plant Instrumentation Bulletin 54-605-83.



Inside view of panel

THE **hays** CORPORATION

MICHIGAN CITY 7, INDIANA

Automatic Combustion Control • Veriflow Meters and Veritrol • Electronic Oxygen Recorders • CO_2 Recorders Boiler Panels • Gas Analyzers • Combustion Test Sets Draft Gages • Electronic Flowmeters • Miniature Remote Indicators • Electronic Feed Water Controls

For more data circle 529 on Post Card

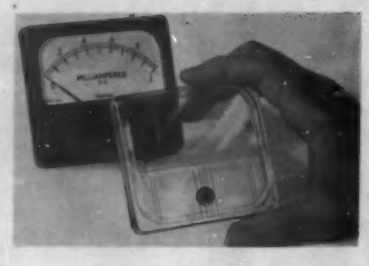
lent electrical characteristics. The duct comes in 11 sizes and in lengths to 6 ft; it ranges in width from ½ to 4 in., in depth, ½ to 3 in. Taylor Electric, Inc.

16—PIPE FITTINGS are injection molded plastic

Announced as the first 3 and 4 in. pipe fittings of unplasticized polyvinyl chloride to be injection molded on a commercial scale, this line includes 90 and 45 deg elbows, tees, couplings and flanges. The larger size PVC fittings make possible economical erection of larger size PVC piping systems now being planned in the chemical, petroleum and other fields. Fittings from ½ in. up are available in normal and high impact PVC, and in threaded and socket types, the latter designed for attachment to pipe by solvent or fillet welding. Fittings provide exceptional resistance to corrosive attack, company notes, and are easy to erect and disassemble. Initial cost is less than piping of other materials usually employed where acute corrosive problems are present. Tube Turns Plastics, Inc.

17—REMOTE INDICATOR for limited space uses

Model 216, a remote reading tank contents indicator, is designed for applications where panel space is limited. A dial type instrument, it has a scale length of 20 in. although occupying a panel space of only about 3 by 10¼ in. It is available for either horizontal or vertical panel mounting. Indicator is used with company's automatic hydraulic actuated tank contents gaging systems, and may be located as far as 250 ft from tank. A self-contained hydraulic system provides indicator actuation. No outside power is required. Where level control is required in conjunction with tank contents measurement, switches are furnished. Tank unit is installed thru a single 2 in. diam opening in tank. Once installed, system is said to require no further maintenance. Bulletin 532 gives more data. The Liquidometer Corp.



19—INSTRUMENTS have one-piece snap-on plastic fronts

The Model 1331 line of flush rectangular instruments (3½ in.) incorporates a self-shielded movement designed to eliminate inter-effect when instruments are mounted closely on the same panel, and to permit mounting on magnetic or non-magnetic panels without special adjustment. The instruments have a one-piece snap-on front with zero corrector. Manufacturer says the entire front surface, except for the window area, can be supplied in any color, including black, for quantity built-in requirements. Case dimensions are 3.80 by 3.44 in. The line offers d-c and rectifier type a-c instruments in popular ranges. Weston Electrical Instrument Corp.

20—REPAIR STICK for damaged galvanized surfaces

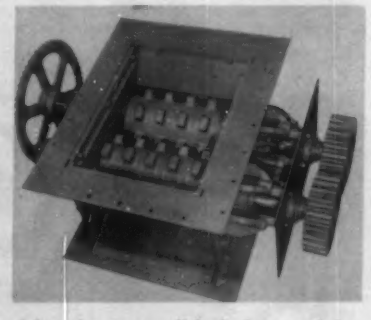
ReGalv is announced as an improved metal alloy stick for regalvanizing areas where the zinc coating (of galvanized sheets, shapes, fittings etc.) has been damaged or destroyed by welding, flame-cutting, bending. The stick is said not to crumble and may be rubbed over the weld or other hot surface to be coated. It melts and bonds at temperatures as low as 600 F, says company, and no pretreatment is required other than knocking or brushing off loose scale. The coating provided by ReGalv is claimed to be as tough, as corrosion resistant and as adherent as the original galvanizing. RotoMetals.

21—ALUMINUM CABLE is lightweight, easier on welders

Tweco-Lite is described as a lightweight aluminum welding cable. Manufacturer says it weighs only half as much as most copper welding cables and its flexibility makes it easier for the welders to work on. The cable is made in Grade SR, with synthetic rubber jacket; Grade N-60, with a 60 per cent Neoprene jacket reinforced with rayon braid. Grade SR is for normal use, and Grade N-60 is suggested for applications where oil, heat, chemicals, abrasion and rough usage are encountered. Both grades are made in No. 4 through No. 4/0 sizes, packaged in pre-cut 50- and 100-ft lengths. Coils of 250 and 500 ft and 1000-ft reels are also available. A further advantage of this aluminum cable is price — reported about 20 per cent less than copper cable. Form TL-107 gives details. Tweco Products Co.

22—CLINKER GRINDER handles wet or dry material

Designed for uniform reduction of ash, slag and other materials, this clinker grinder incorporates double roll construction. This offers several advantages over single roll types, says company: first, by reason of its geometry, it can handle larger clinkers; second, the desired maximum size of end product is maintained; third, wear is less because



sizing is accomplished by applying tremendous pressure at a few points of contact, rather than by attrition.

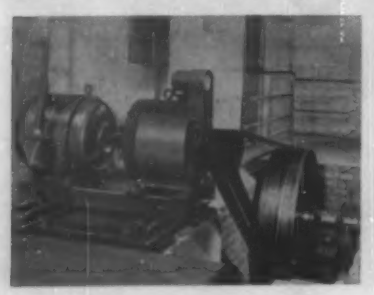
The grinder can be operated with its rolls submerged. There's claimed to be no danger of damage from water, grit or dust, because bearings are mounted outside shaft stuffing boxes and are protected by lantern rings. When handling dry material, compressed air sweeps through glands and bearings to prevent entrance of grit. Water is used with wet material. Equipped with 10-in. diam rolls mounted on 12-in. centers, the grinder reduces clinkers to 2-in. maximum dimension. Rolls come in 2- or 3-ft lengths. Because the grinder is a compact unit with rolls mounted in a steel housing, it can be installed as a unit in a closed system and readily removed for overhaul. The Allen-Sherman-Hoff Co.

23—CONTROL SYSTEM for dual-tank zeolite softeners

This system is part of a completely pre-engineered zeolite softening unit including electrical control panel, flow meter, automatic multi-port valve, zeolite softeners, brine measuring tanks and connecting lines. A feature is an electri-

18—ADJUSTABLE SPEED DRIVE offers flexibility, wide application

Claimed so easy to handle, install and operate that it can be used as a general purpose drive, the Ampli-Speed can be coupled or belted to an existing motor to provide a speed control of ±2 per cent for fans, centrifugal pumps and compressors, says manufacturer. It is also designed to handle constant torque loads such as mills, conveyors, machine tools. With it, company explains, you can operate a load at the optimum speed; change speed smoothly by means of a knob or control it automatically; use the drive for test and development work; control output of fans, pumps and compressors; increase efficiency of pump and fan drives.



The system consists of 1) the Ampli-Speed Drive installed between the motor (or other drive) and the load, 2) a wall-mounted magnetic amplified speed control, and 3) a control rheostat mounted where convenient. The drive can be installed easily, it is pointed out, because it is air cooled and needs no external cooling system, is handled like a motor, and can be belted or coupled to the motor and load. The drive itself consists of a "ring member" connected to the input shaft and driven to the motor, and a "magnet member," mounted on the output shaft, which turns the load. There is no solid physical connection between ring and magnet member, although they are connected through two bearings. The drive is designed for use with motor speeds of 870, 1150 or 1750 rpm. Ratings range up to 95 hp for fan-type loads. For constant torque loads, the output ranges up to 75 hp, depending on input speed and required speed range. Bulletin 4400-PRD-229 gives full information. Electric Machinery Mfg. Co.

WHAT'S WRONG WITH H_2O?

Nothing . . . except that it's so rarely found in its pure state. Even rain, nature's closest approach to pure water, contains carbon dioxide and dissolved oxygen. So it is, in varying degrees, with every surface or underground water supply. All waters have certain corrosive impurities that must be corrected or neutralized before they can be economically used. That's where we come in.

Since 1887, Dearborn has worked with water to make water work better and more economically for you. That's why, today, industrial and commercial businesses of every size and type look to Dearborn for consultation and assistance in problems like—

- ☆ **Internal or external feed water treatment**
- ☆ **Steam purity control**
- ☆ **Feeding, softening or de-ionizing equipment**
- ☆ **Cooling water or process water treatment**
- ☆ **Water reclamation**
- ☆ **Industrial waste treatment**

This broad experience of Dearborn's is available to you. Your Dearborn Water Treatment Engineer will gladly explain the advantages of Dearborn Supervisory Service—a program in which you use only the amount of service you need.

Why not investigate? There's no obligation.

Dearborn®

LEADER IN WATER CONDITIONING AND RUST PREVENTION

DEARBORN CHEMICAL COMPANY

MERCHANDISE MART PLAZA • CHICAGO 54, ILLINOIS

Dearborn Chemical Company, Dept. PG
Merchandise Mart Plaza, Chicago 54, Illinois

☐ Please furnish more information on Dearborn Water Conditioning

☐ Have a Dearborn Water Treatment Engineer call

Name.....*Title*.....

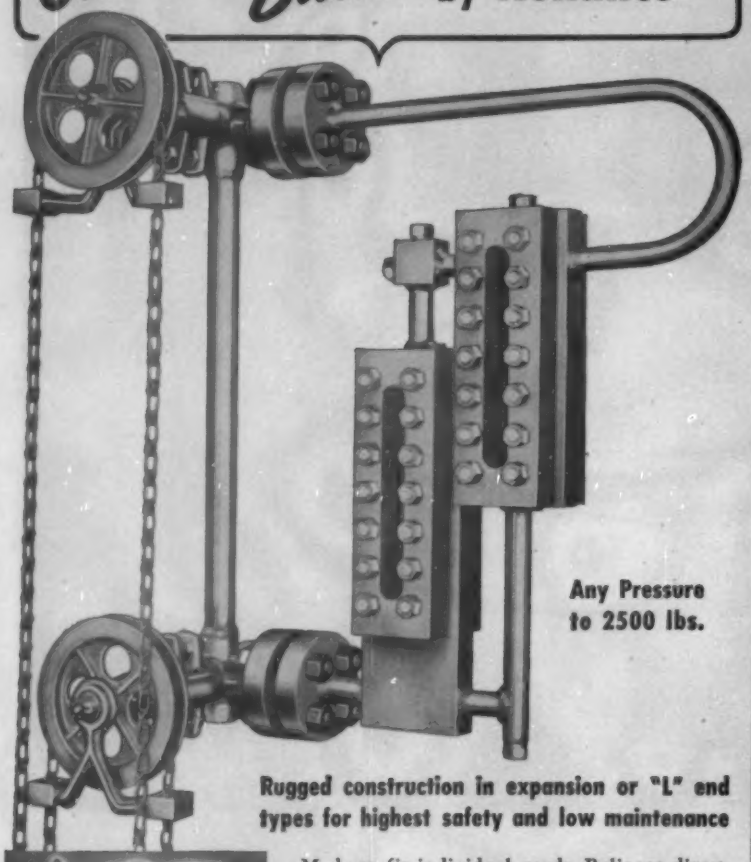
Company.....

Address.....

City.....*Zone*.....*State*.....

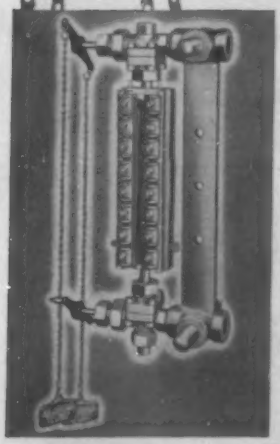
For more data circle 530 on Post Card

Direct-to-Drum Gage Assemblies *Custom Built* by Reliance



Any Pressure to 2500 lbs.

Rugged construction in expansion or "L" end types for highest safety and low maintenance



Made to fit individual needs, Reliance direct-to-drum assemblies meet highest engineering and construction standards. Reliance all-welded gage assemblies have more than sufficient ruggedness for severest conditions. Each unit is tested at well over 50% overload before it leaves the factory.

In the expansion tube type, a sturdy tie-tube is welded to both gage valves for rigidity between boiler connections. Gage windows are Mica-protected flat glass (to 1500 lbs.) or non-shattering Micasight — safest gage obtainable for the higher pressures. Valves — heavy duty forged steel, temperatures to 750°. Various combinations possible in other types, pressures 900 to 2500 lbs. Efficient illumination equipment available, including the powerful mercury lamp type. Write the factory or nearest Reliance Representative.

The Reliance Gauge Column Co., 5902 Carnegie Ave., Cleveland 3, Ohio

Reliance®

BOILER SAFETY DEVICES

For more data circle 531 on Post Card

cal control panel containing a series of relays and a multiple-cam timer which initiate periodic, timed regeneration of softeners. Incoming raw water is measured by inlet water meter register. When a predetermined volume has passed through meter, a contact automatically closes beginning regeneration circuit. One relay is immediately locked in while another is locked out so that only one softener will be regenerated at a time. This relay in turn starts timer motor which rotates a cam shaft through a series of switches each of which positions the multi-port valve for successive backwash, inject-displace, rinse and service operation.

Rotation of valve port for these positions is done by a lift-turn arrangement consisting of a spiral grooved, guided shaft and attached diaphragm assembly. Valve remains in one position only when water pressure on either side of diaphragm is equalized. A solenoid bleed valve provides pressure variation to turn valve rotor. Once regeneration cycle is completed and valve returns to service position, inlet meter register is also reset. Simultaneously, timer reset switch is tripped releasing lockouts and permitting new cycle to start. If desired, manual controls can be used. Graver Water Conditioning Co.

Reader Service Cards on pages 117–118 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

24—PROCESS GAGES in cast case and blow-out back design

Two new series of gages for the process industries are trade-named Supergauges and Solfrunts. The former are available in cast case construction, while Solfrunts have a solid front with safety blow-out back to protect workers. According to manufacturer, these gages offer longer life, accuracy and readability not obtainable in many smaller gages. The nylon-faced stainless steel segment with stainless steel pinion are said to afford extended life under severe operating conditions.

Other features common to both lines include mono-unit construction for easy removal of entire gage assembly from case, and rapid adjustment without removal of dial. The gages come in 4½-, 6- and 8½-in. sizes; and are available in back flange, front flange and turret type cases. U. S. Gauge Div., American Machine and Metals, Inc.

25—TEST KIT for measuring hardness of water

The hardness of water delivered by water softeners can be measured to the nearest 0.2 grain per gallon in an on-the-spot test that takes one minute, it is announced, with the inexpensive pocket-size Zeo-Kit which enables quick determination of when softeners need regenerating. Contained in a white plastic box that measures 4⅜ by 1¾ by 1 in. the 3-oz kit consists of a glass vial and a dropper bottle holding 1 oz of softener reagent — enough for 140 tests

THE GREATEST NAME IN ELECTRICAL WIRE AND CABLE

RUBBER and PLASTIC POWER and CONTROL CABLES

When you need Rubber and Plastic Power and Control Cables . . . look to General Cable . . . for every type, for every use . . . for fast deliveries . . . for UNMATCHED QUALITY! These General Cable products have earned an enviable reputation among users for transmission, distribution and control . . . for direct earth burial . . . for duct and conduit . . . for submarine use . . . and for self-supporting aerial applications.

As the biggest producer, General Cable makes the widest range of types. To mention a few: low and high voltage power cables, signal control and alarm cables, self-supporting aerial cables, interlock armored bus drop cable.

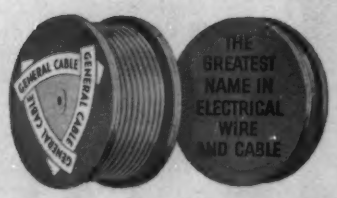
Constructions consist of copper and aluminum conductors. Insulations: GENCASEAL (Thermoplastic Vinyl), polyethylene, THERMAX W (moisture and heat resistant), AQUASEAL (heat and moisture resistant — low SIC), GENCORONE (ozone-resistant oil base), BUTARONE (ozone-resistant butyl base).

Outer coverings include rubber, neoprene, GENCASEAL, lead, reinforced neoprene over lead, and textiles (cotton, glass, asbestos, sisal, jute, rayon).

Armor finishes include steel, bronze, aluminum interlock; flat steel, and galvanized wire armor.

These popular and versatile products are made to meet *every* operating condition. Where standard types are not suitable for your particular use, special constructions will be made to meet your exact needs. Get the complete facts before you buy. Let our engineers help to solve your wire and cable problems. And, remember, that General Cable is the *only* manufacturer who can supply *all* your wire and cable needs!

GENERAL CABLE
CORPORATION



BARE, WEATHERPROOF, INSULATED WIRES and CABLES FOR EVERY ELECTRICAL PURPOSE

GENERAL CABLE CORPORATION
Executive Offices: 420 Lexington Ave., New York 17, N. Y.

SALES OFFICES: Atlanta • Baltimore • Boston • Buffalo Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit Erie (Pa.) • Greensboro (N. C.) • Houston • Indianapolis Kansas City • Lincoln (Neb.) • Los Angeles • Memphis Milwaukee • Minneapolis • New Haven • Newark (N. J.) New York • Philadelphia • Pittsburgh • Portland (Ore.) Richmond (Va.) • Rochester (N. Y.) • Rome (N. Y.) St. Louis • San Francisco • Seattle • Springfield (Ill.) Syracuse • Tampa • Tulsa • Washington, D. C.

For more data circle 532 on Post Card

Seattle City Light
saves 25%
valuable floor space
on this installation of C & D Control Batteries

Installation of C & D 60-PL-17 PlastiCell Control Batteries. Battery capacity: 440 A.H. Estimated life: more than 15 years.

Seattle City Light, one of the Pacific Northwest's largest utilities, joins the growing list of utilities and municipalities that are using C & D for an economical and dependable source of battery power. Once again, C & D leads the field with an important "first"—the *first* battery specifically designed for control, switchgear, and auxiliary power applications!

By replacing its old installation with C & D PlastiCell Control Batteries, this progressive utility saves 25% of valuable floor space for other purposes. C & D Batteries also provide these "more battery for the money" advantages—

1. Triple insulation—thick Fibreglas mat, microporous separators, and perforated Koroseal retainer.
2. Extra-long life—Exclusive design combines advantages of both suspended and supported plate construction.
3. Saftee-Vent—outstanding C & D development that prevents accidental battery explosions.
4. Crystal-clear plastic jars—heat resistant and hermetically sealed.
5. Plastite post seals—for easier maintenance.

for details . . . Write for new C & D Specification Bulletin: CP-537 (Rev. 1) on "PlastiCell Batteries." If you are interested in 25-year battery life—ask for Bulletin CP-536 (Rev. 1) on PlastiCal batteries.

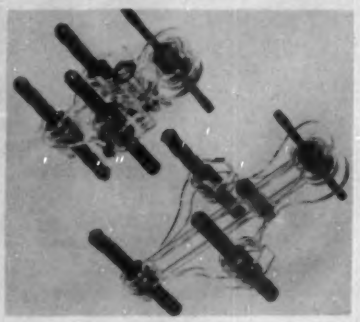
C&D BATTERIES, INC.
of Conshohocken, Pa.
Industrial Batteries Since 1906
Sales and Service Offices in Principal Cities from Coast to Coast

For more data circle 533 on Post Card

on water averaging 0.5 grain per gallon. When the reagent is added, water sample turns first red and then blue — the number of drops of reagent needed to turn it blue determines hardness of water. Bullet 7RE55 gives details on the kit. Calgon, Inc.

26—AERIAL CABLE cuts down distribution cost

Improved performance and savings in purchase, installation and maintenance of power lines are claimed for this cable and suspension. Instead of spiralling insulated conductors tightly and binding them to the messenger cable that supports them, the system employs acrylic plastic insulating clamps at 30-ft intervals to hold conductors closely spaced and attached to messenger. Two sizes space the conductors 3 and 6 in. equilaterally and are called Tri-3 (shown at

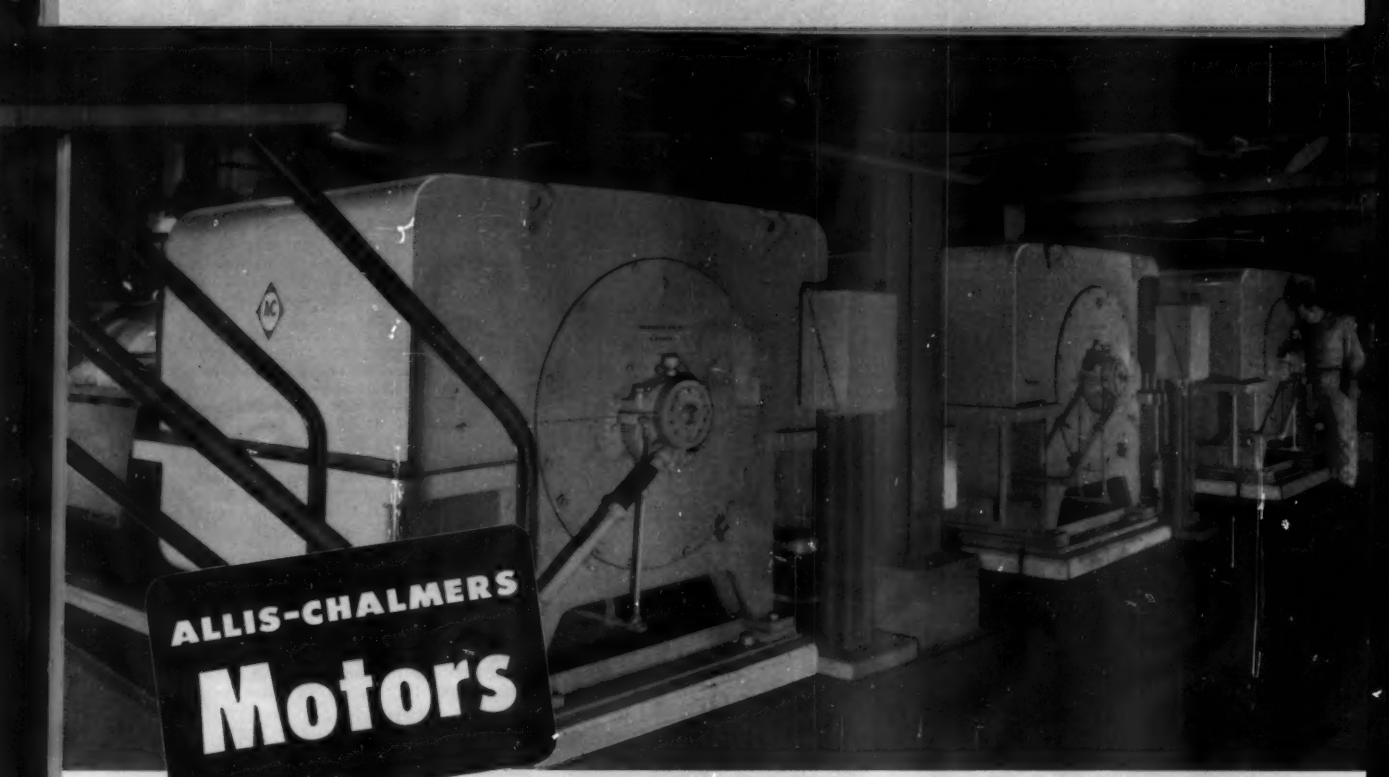


top) and Tri-6 Hendri-clamps. The first is used for voltages less than 5000v and the Tri-6 for those over 5000v, although the large clamp may be used on the lower primary voltages at 40-ft intervals. In the Tri-6 system, rated at 15,000 v, each clamp weighs but 1.4 lb and aluminum cable requires only relatively light insulation — the lighter weight making longer pole spans more practical, says company.

Linemen approve the system, it is noted, because all four wires are in front of them as they work the cable hot. Circuits can be worked hot using rubber-hose and open wire safety methods. The 5000 v phase conductors are insulated with vinyl plastic tape. Conductors and messenger are pulled into position on the poles and clamped in the Tri-3 and Tri-6 clamps. The clamps consist of two sections, molded to ¼ in. thickness. When the sections are bolted together, openings in adjacent hooks are 180 deg apart, forming a ring housing for bushing and for cable within it. Conductors and messenger are supported in rings by Neoprene bushings, split for easy installation and molded with different inside diameters to fit conductors. F. J. Kirk Molding Co.

27—AIR COMPRESSOR designed to deliver oil-free air

Announced as radically new in design, this high capacity piston type air compressor is said to deliver perfectly oil-free air. All units are constructed for continuous operation while delivering up to 175 psi pressure. Industrial applications are said to be limitless — instead of one central compressed air station supplying air for countless industrial duties, individual motor driven, oil-less compressors can be mounted



Driving ALL Major Auxiliaries

at Houston's New Webster Station

Weather-protected Allis-Chalmers motors are used throughout the modern outdoor Webster Station of Houston Lighting and Power Company. They provide low-cost outdoor installation plus dependable operation under all weather conditions.

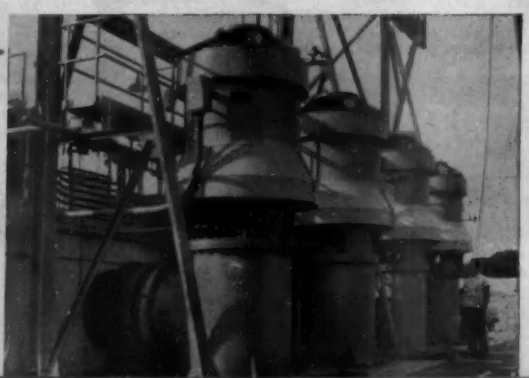
These motors are but a few of the complete line of motors Allis-Chalmers builds for power plant service. Check with the A-C office in your district or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin. A-4832

Three of the six 1750-hp, 3575-rpm, 2300-volt Allis-Chalmers two-pole motors providing unusually quiet drives for boiler feed pumps.

Two 350-hp, 1170-rpm, 440-volt Allis-Chalmers condensate pump motors.

One of four 1250-hp, 880-rpm, 2300-volt cage motors driving forced-draft fans.

ALLIS-CHALMERS



A-C ALLIS-CHALMERS

Four 800-hp, 514-rpm, 2300-volt vertical Allis-Chalmers circulating water pump motors.

Engineers and Constructors — Ebasco Services Incorporated

IT'S FLATTERING TO BE IMITATED

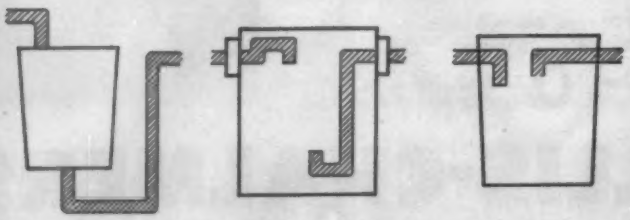
● Old Davy would be mighty flattered if he were here to see his imitators. We, too, at Anderson are flattered that so many trap manufacturers have imitated Super-Silvertop's straight-through piping. Such action acknowledges Super-Silvertop's leadership.

Years ago we discovered if properly designed a steam trap could be installed as an elbow or straight-in-line saving 9 pipe fittings and a half-hour's labor. Although many other traps are now using the straight-through design, there is still a basic important difference. They only offer the straight-through design and not optional design of either straight-through or elbow inlet connection. Also their design is available in only a few sizes and is obtained by means of building piping into the trap, instead of a truly engineered design. Built-in piping results in narrow, thin-walled, hard to clean, cored passages that can cause gaskets to blow.

The next time you buy or specify, select Super-Silvertops with straight-through and elbow installation . . . in all sizes.

THE V. D. ANDERSON CO.
1977 West 96th Street
Cleveland 2, Ohio

Only SUPER-SILVERTOPS offer Simplified Piping Without the Use of Narrow Thin-Walled Passages



This conventional design requires 9 fittings and complicated piping.

This design eliminates the fittings but results in narrow cored passages.

Only Super-Silvertop eliminates narrow-cored, thin-walled, passages.

SUPER-SILVERTOP Steam Traps

Quality Steam Traps Since 1886

For more data circle 535 on Post Card

where compressed air is needed. Portability and low cost make them adaptable to all types of industrial maintenance, it is pointed out, and oil-free feature suits them to pneumatic tools and control systems.

The use of specially constructed graphite or carbon piston rings accounts for the oil-less feature. External mix type spray guns allow cleaning without dismantling. Units are rated for continous operation at 35, 75, and 175 lb and from ¼ to ¾ hp. Types available include motor compressors, tankless units with check valve and automatic pressure switch, tank units with automatic pressure switch and check valve, and others. Bell & Gossett Co.

28—TUBE PILOT useful in replacing tubes

This tube pilot is said to meet a special need of the power engineer, who is replacing tubes in condensers and heat exchangers. Its use is to pilot tubes

through the tube sheet and tube support plates. Pilot consists of a hardened steel nose with a replaceable nylon brush attached. Brush fits snugly in end of tube, centering and holding pilot firmly in place. It is easily removed from tube by a slight twist. The brush also cleans the tube where it will be rolled. Pilots are made for tubes 1¼ in. and smaller. Elliott Co.

29—SWITCHBOARDS utilize new "building block" concept

What is announced as a new basic "circuit" concept in switchboard design involves use of pre-engineered basic circuits in the design of control switchboards. Manufacturer points out that there are 11 basic circuits which cover applications for most switchboard users. Each circuit includes basic instruments, meters, control devices and relays necessary to perform a desired function. Components of a circuit group on the control and relay sides of switchboards are arranged opposite each other for operating simplicity. As a result, it is noted, switchboard operators can easily visualize circuits. Other advantages cited are less detail planning, and determination of switchboard size before orders are placed.

The 11 functional basic circuits of the new design are 1) a-c feeder with overcurrent protection; 2) a-c feeder with directional overcurrent protection; 3) power transformer; 4) tie line with wire pilot differential protection; 5) transmission line with carrier current directional comparison protection; 6) transmission line with directional distance protection; 7) small a-c generator; 8) large a-c generator; 9) unit generator-transformer; 10) bus differential protection; and 11) synchronizing equipment. A basic circuit switchboard can be selected from specification sheets available for each of these circuits. These sheets list elements of the circuits, show a diagram of the circuit, give layout of the board. General Electric Co.

more Equipment News page 130

HALL LABORATORIES, INC.—A SUBSIDIARY OF HAGAN CORPORATION, PITTSBURGH, PENNSYLVANIA

Hall Industrial Water Report

VOLUME 3 OCTOBER 1955 NUMBER 5

It Takes a Lot of Water Conditioning To Manufacture Paper

Ten billion tons of water are required annually for many uses in the papermaking industry. Production has increased from less than one ton per day in the first mill in the United States to 26,656,000 tons in 1954. Water-connected problems of all kinds are handled in over two hundred papermaking plants by Hall service engineers.

Pollution Abatement Program Cited by State Authorities

In connection with its waste disposal problem, an eastern paper manufacturer with the advice of Hall Laboratories set up an investigative and remedial program supervised by Hall staff engineer Herman A. Reda.

The plant had been discharging its industrial waste waters into a waterway supplying a city of 130,000. Pollution was so severe that septic conditions developed when there were periods of low flow. The fact that potable supplies were affected made the situation quite serious.

The removal of contamination, required by the state, was accomplished by utilizing air flotation units to clarify the water and remove the pulp fiber. This equipment functioned so efficiently that both the water and the fibers of pulp could be re-used. The selection of this equipment was based on pilot plant studies which indicated a 97.1 percent removal of suspended solids and a 95 percent reduction in oxygen consuming material.

$100,000 per year is the plant's estimate of the value of the reusable pulp recovered by the in-plant changes and treatment processes recommended by Mr. Reda. Sufficient clarification of white water to permit re-use on the paper machines reduced the plant over-all water consumption.

The reduction of wastes at their sources was, of course, one of the most important results of this work. In their report to the General Assembly of Delaware, the Commission stated that the cooperation received from industry in this particular study, investigation, and follow-up was most satisfactory and exemplary.

Maintenance Cost Reduced

A Canadian newsprint plant was running efficiency tests throughout the plant. At the suggestion of Hall engineer J. C. Skerrett, the plant carried out a three-month test on a paper machine to determine the effect of Hagafilm® in improving heat transfer by cleaning out old corrosion products and controlling return line corrosion.

Pleased with the results of this test, the plant decided to run a test on their Flakt dryer, a separate unit, where leakage due to corrosion was a problem. Overtime for weekly welding of the interconnecting piping of the steam and condensate headers was a costly item.

Leaks stopped within one week after a Hagafilm feed of 2ppm was started, and since there has been no recurrence after six more weeks of operation, it is obvious that maintenance has been reduced to almost the vanishing point.

Hall Engineer Reports on Service

Putting a new boiler into operation can bring up some unexpected problems as the following reports from a Hall engineer on another paper plant show.

Discussed recommendations outlined in my letter to the plant. Lined up plant for boiling out new boiler. Also discussed variations in raw water characteristics.

Returned to plant for initial operation of hydrogen zeolite unit. Suggested that plant start to decrease rate of blowdown as more of the blended water is used. Boiler-water test results showed deficiencies of phosphate and sulfite. Had them increase feed of chemicals.

Went over operation of sodium-hydrogen zeolite unit setup. Found that system was cut into service only twice a day as the clear well level did not drop appreciably. Checked clear well water to determine whether or not raw water was getting into the system and found it O.K.

Learned that the plant had been operating for four days with an acid boiler water. Investigation indicated the cause to be faulty operation of the flow control valve. Immediately cut off the hydrogen zeolite unit and went to straight sodium zeolite make-up.

Called to check on plant since we eliminated the acid in the boiler water. Boiler-water alkalinities now around 16 ml and plant is again blending the sodium-hydrogen zeolite water.

A while ago I alerted the plant to the fact that something was wrong in the setup because of unexplainable high alkalinity and high phosphate consumption. My checks on the clear well and condensate revealed nothing. However, about ten days ago, things became very upset and clear-well water indicated contamination. Investigated and found that main sewer line carrying backwash water from raw-water filters was broken and that there were cracks in the clear well. The sewer runs alongside the clear well. Contamination occurred whenever level in the clear well was low, allowing water to seep in.

Director of Hall Laboratories Receives A. S. T. M. Award

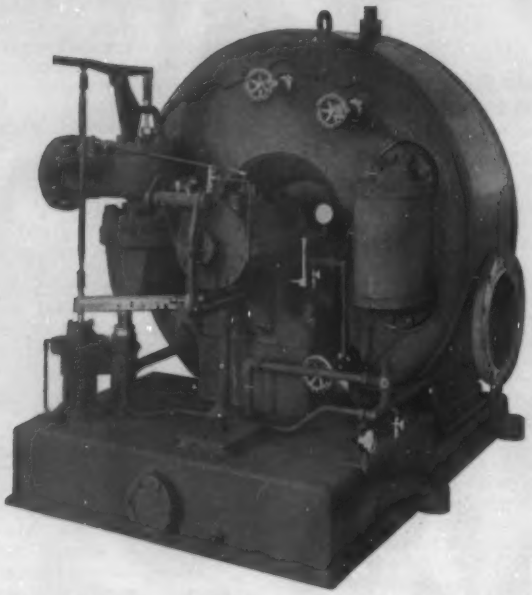
Dr. Everett P. Partridge has received the 1955 Max Hecht award of the American Society for Testing Materials for "30 years of outstanding contributions to the technology of industrial water."

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information write, wire or call Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

Water is your industry's most important raw material. Use it wisely.

TROUBLE-FREE TURBINE OPERATION STARTS HERE



Terry solid wheel turbines have become a symbol for dependable, trouble-free operation. The reason—simplicity and ruggedness of construction.

Take the rotor, for instance. It's a solid forging in which a series of semi-circular buckets is milled. There are no separate parts to loosen or work out. Since the only function of the blades is to form a series of pockets, any wear which might occur would not materially affect horsepower or efficiency.

It is impossible for the blades to foul. They have large clearances and are further protected by the projecting rims at the sides of the wheel. As the side clearances are also very large, end play can do no harm.

Simplicity outside too—as you can see from the photograph of the 1500 HP at 3500 RPM solid wheel turbine above. This turbine is equipped with an oil relay governor and forced feed lubrication to the bearings.

For more about these *work horses of industry*, send for a copy of bulletin S-116. No cost or obligation.

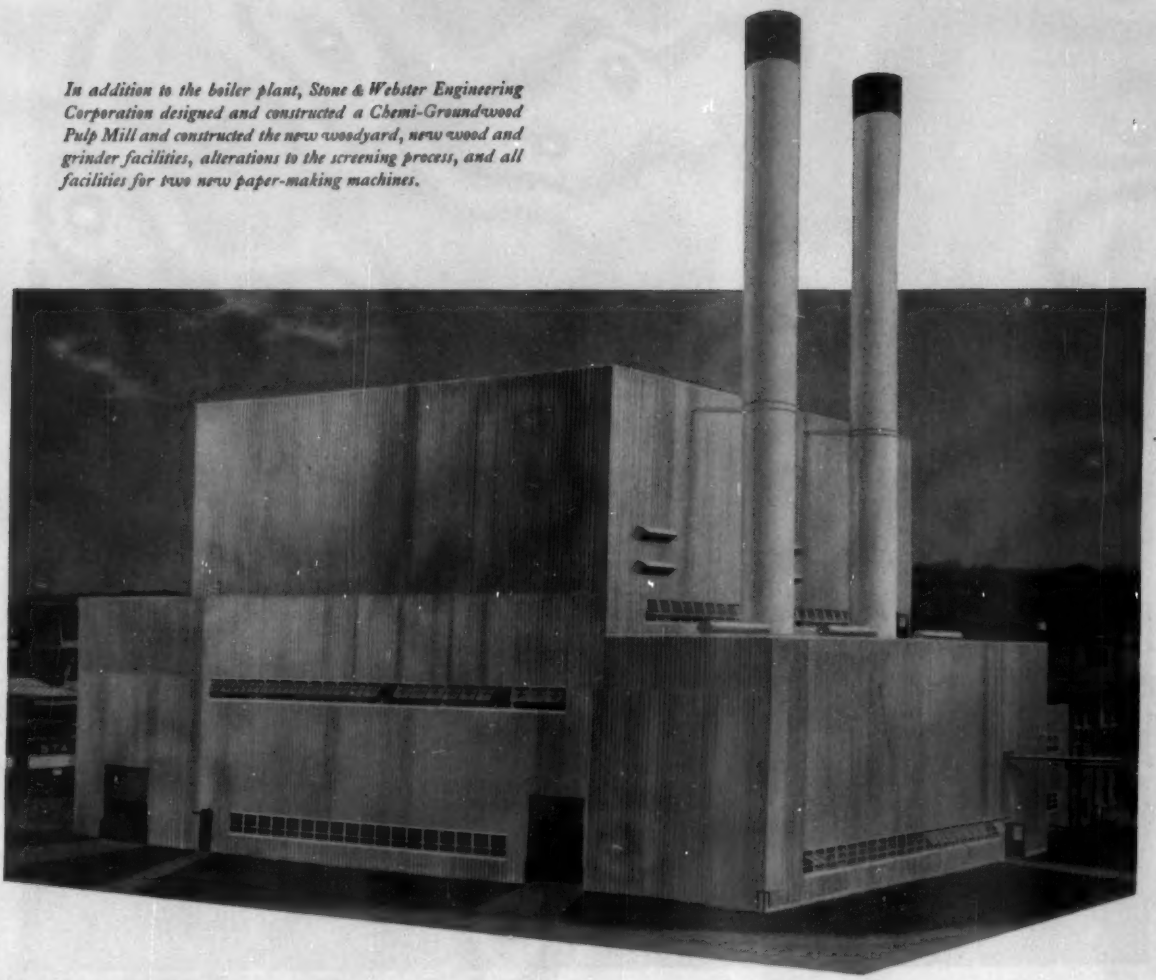
THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

IT-1200

For more data circle 537 on Post Card

In addition to the boiler plant, Stone & Webster Engineering Corporation designed and constructed a Chemi-Groundwood Pulp Mill and constructed the new woodyard, new wood and grinder facilities, alterations to the screening process, and all facilities for two new paper-making machines.



POWER FOR NEWSPRINT PRODUCTION

As part of Great Northern Paper Company's extensive expansion of its newsprint plant at East Millinocket, Maine, Stone & Webster Engineering Corporation was retained to design and construct a new power station.

The station, which produces steam for power and processing, is of modern, compact design. There are two oil-fired boilers generating 300,000 pounds of steam per hour at 1250 psi, and a 12,500 kw turbine generator, with provision for a second unit of equal capacity.

Write or call us for information as to how our experience may be of assistance to you.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY *of* STONE & WEBSTER, INC.

New York Boston Chicago Pittsburgh Houston San Francisco Los Angeles Seattle Toronto

For more data circle 538 on Post Card

Handles Hot Loads At Cool Savings

Hundreds of installations—in different industries, under various conditions, in every section of the country—have proved beyond question that Kaloric-Type 890 is the best heat-resistant conveyor belt on the market. It is specially engineered to handle hot materials—*very* hot materials, even up to 350°. Under favorable conditions it will withstand much *higher temperatures!*

Among the hot substances successfully conveyed by this unusual belt are: coke, limestone, cement, fertilizer, sintering, ores, slag, fuller's earth, char, foundry shakeout sand, sugar crystals, soda ash, chemically processed oxide, refractory mix, glass, asphalt and talc.

All Kaloric-Type 890 belts are made with a special Neoprene compound that gives the best heat resistance. They are available in three carcass constructions: for temperatures up to 250°F., multiple plies of cotton duck; for temperatures above 250°F., plies of a special cotton and glass fiber duck. These are woven with cotton in one direction and fiber glass in the other, and each ply reversed in direction of glass and cotton. Skim coats are applied between plies for insulation and extra flex-life. Extra heavy top covers of special heat resisting compound (¼" to 5/16" are not unusual) resist temperatures that would cause ordinary belt covers to harden and crack.

Kaloric-Type 890 belts are available in widths up to 72", any length, two to ten plies, with cover thickness to suit any conditions.

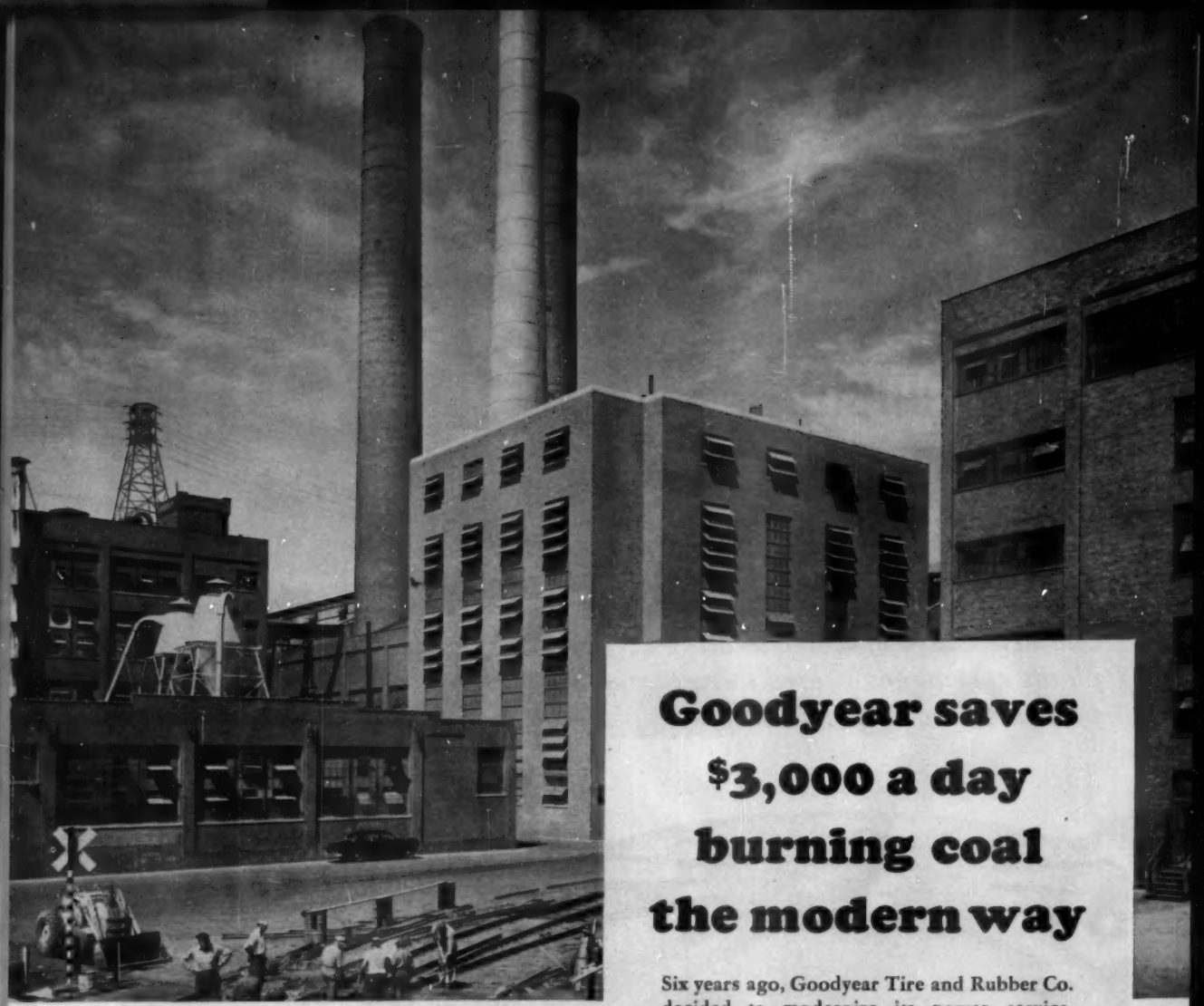
We also manufacture a complete line of industrial rubber products: belting, hose, packing and moulded rubber of every need. *Through your Quaker and Quaker Pioneer distributor* our research and engineering services are available to help you solve any industrial rubber problem. *Write for free folder and name of nearest distributor.*

DIVISIONS OF H.K. PORTER COMPANY, INC.

QUAKER RUBBER CORPORATION
Philadelphia 24, Pennsylvania

QUAKER PIONEER RUBBER MILLS
San Francisco 7, California

For more data circle 539 on Post Card



Goodyear saves $3,000 a day burning coal the modern way

Six years ago, Goodyear Tire and Rubber Co. decided to modernize its power service. Among other considerations, 70% of the firm's steam-generating equipment was over 30 years old. As a result, operating efficiency was only 65%. Power needs at Goodyear's Akron plants ran so much greater than capacity that additional power had to be purchased. Goodyear engineers and engineering consultants, Sargent & Lundy, were called in to study the problem and recommend a solution.

Now two 220,000 lb.-per-hr. boilers have replaced six 50,000 lb.-per-hr. units. Coal and ash handling are automatic. Controls are fully automatic. And not only have these and other changes resulted in dependable power service, but steam generating efficiency is now 82%—saving Goodyear $3,000 a day. For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

NATIONAL COAL ASSOCIATION
Southern Building, Washington 5, D.C.

Consult an engineering firm

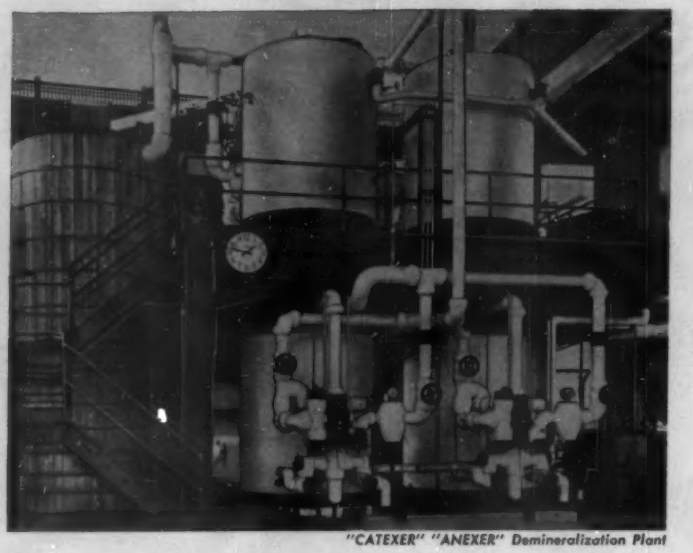
Designing and building hundreds of heating and power installations a year, qualified engineering firms can bring you the latest knowledge of fuel costs and equipment. If you are planning the construction of new heating or power facilities —or the remodeling of an existing installation—one of these concerns will work closely with your own engineering department to effect substantial savings not only in efficiency but in fuel economy over the years.

facts you should know about coal

Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems result in a virtually labor-free plant • Coal is the safest fuel to store and use • No dust or smoke problems when coal is burned with modern equipment • In most industrial areas, bituminous coal is the lowest-cost fuel available • Between vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and it's price remaining stable.

For more data circle 540 on Post Card

Your boiler feedwater problem is different!



"CATEXER" "ANEXER" Demineralization Plant

That is why INFILCO offers you a complete range of water treating plants custom engineered to meet your particular requirements. For example–

If you use high pressure boilers, you might require a CATEXER® ANEXER® Demineralization Plant. These plants give you improved make-up quality, adequate supply regardless of station electrical load, reduced overall operating costs, and lowered maintenance costs and labor expense.

For low pressure boilers, the ACCELATOR® Treating Plant offers a most economical means of treating feedwater. It is also frequently recommended for pre-treating make-up water for high pressure boilers. "ACCELATOR" Clarifiers and Softeners have a proven record of flexibility and ease of operation.

Feedwater for intermediate boiler pressures can often be treated by INFILCO Hot Process Softeners. These softeners are noted for their accurate treatment control and superior performance. They are often used in combination with Hot Process Zeolite Softeners.

"ACCELATOR" Treating Plant

Whatever your feedwater problem, you can depend on the complete engineering know-how and many years experience that have made INFILCO a leader in this field. Why not submit your problem today. INFILCO engineers will suggest a practical solution. Write for information.

Hot Process Softener

INFILCO

The one company offering engineered equipment for all types of water and waste processing—coagulation, precipitation, sedimentation, flotation, filtration, ion exchange and biological treatment.

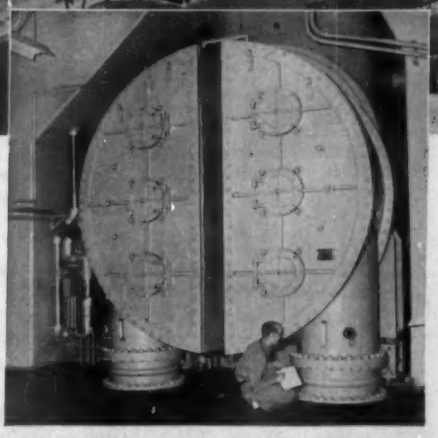
INFILCO INC. 918 S. Campbell Ave., Tucson, Arizona
Field offices in principal cities in North America 5537

For more data circle 541 on Post Card

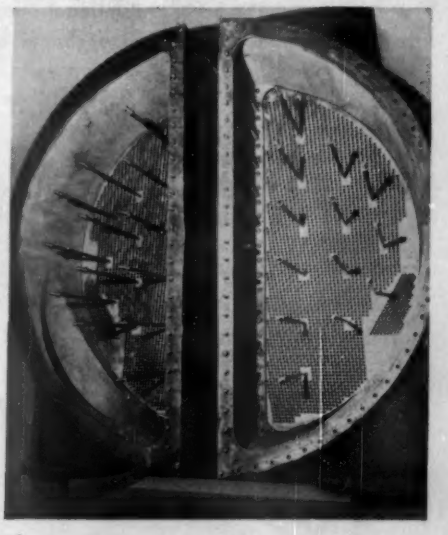
A. W. HIGGINS PLANT of the Florida Power Corporation on Tampa Bay.

REVERE 10% CUPRO-NICKEL SOLVES CORROSION PROBLEM FOR FLORIDA POWER CORPORATION

About six years ago the Florida Power Corporation was experiencing condenser tube failure at its Bayboro plant in St. Petersburg. Revere's Technical Advisory Service was called in, and recommended replacing the failed tubes with 10% Cupro-Nickel, which has a marked resistance to corrosion from brackish water. This recommendation proved successful. As a result, when Florida Power planned to add a new 135,000 KW plant, named after A. W. Higgins, Revere 10% Cupro-Nickel tubes were specified. All three units in the new plant are thus tubed. The tubes are $\frac{7}{8}$" OD x 18 BWG, 24' 7" long. A few spares are kept on hand for possible replacement, but with regular cleaning to remove debris (small bits of shell, etc.), the tube life has been exceptional, thus adding to economy of operation and increased service to a fast-growing area. . . . If you have questions regarding condenser tube selection and service, get in touch with the nearest Revere Sales Office. Remember to specify Revere.



Exterior view of one of the condensers in the Higgins plant, and below, one of the three condensers ready for tubing. Condensers made by C. H. Wheeler Mfg. Co., Philadelphia, Pa.



REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N.Y.

Sales Offices in Principal Cities, Distributors Everywhere.

For more data circle 542 on Post Card

THE HEAT'S ON
... and fast!

YARWAY Impulse Steam Traps get equipment hot in a hurry, and *keep* it hot.

As soon as steam is turned on—SNAP—the little stainless steel valve opens wide, discharges condensate and air *continuously* until steam arrives. Then—SNAP—the valve shuts. Equipment reaches operating temperature in the shortest possible time.

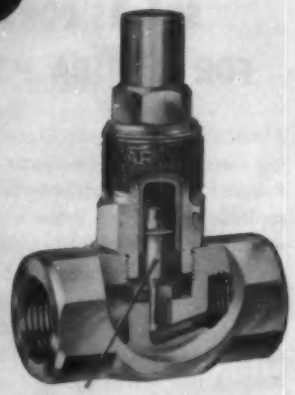
After that the little valve actually *floats on the condensate load*—maintains peak temperatures.

Other YARWAY features:

- **Stainless steel—body and internal parts.**
- **Good for all pressures without change of valve or seat.**
- **Low maintenance—one moving part.**
- **Easy installation—small size, light weight.**
- **Non-freezing at low temperatures.**
- **Six standard sizes, ½" to 2".**

Want *proof* of performance? Try a YARWAY Impulse Trap and Fine Screen Strainer FREE for 90 days in your own plant. For free trial, or free catalog, write . . .

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.



This little valve—only moving part in a YARWAY Impulse Steam Trap—*floats on the condensate load*. It gets equipment hot in a hurry and keeps it hot!

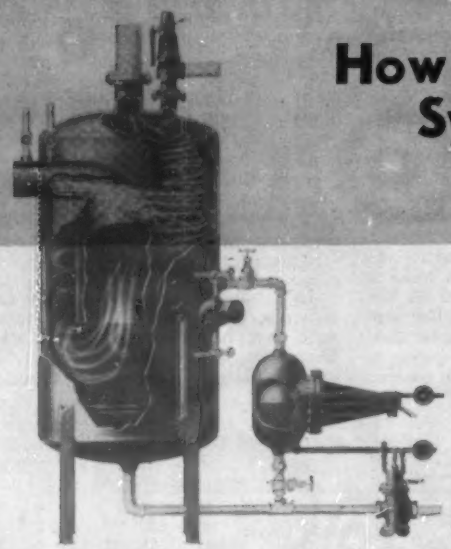
YARWAY
impulse
steam trap

OVER 1,000,000 YARWAY IMPULSE TRAPS SOLD—STOCKED BY 270 CONVENIENT INDUSTRIAL DISTRIBUTORS

For more data circle 543 on Post Card

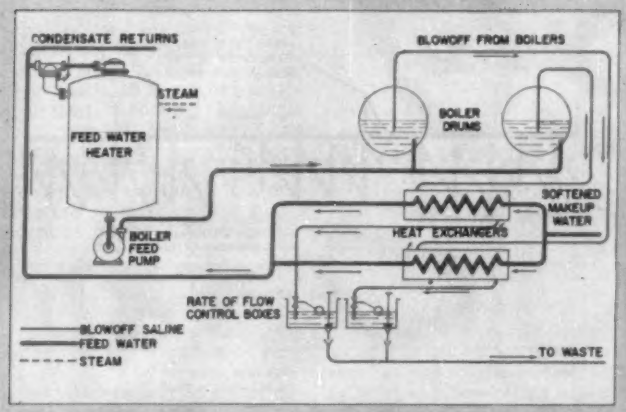
How to Pick the Blowdown System You Should Use

By RALPH M. LEMEN*



The advantages of continuous boiler blowdown over intermittent manual blowdown methods, in most all applications, are generally acknowledged; question remaining is type of continuous blowdown to use. Here, clearly outlined, are the four types so you can pick one best for you

Fig. 1. Cutaway view of a single-stage flash tank system shows tangential flow



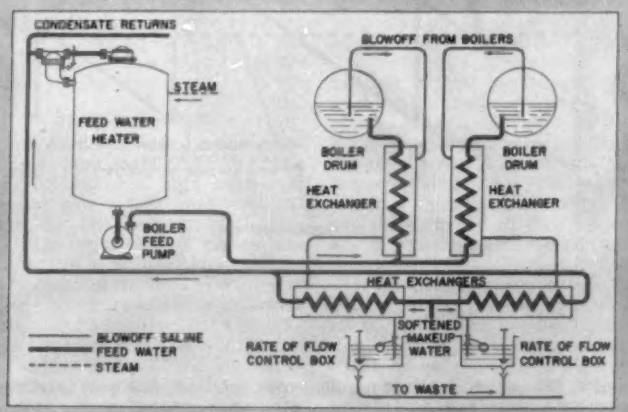


Fig. 2. Graphic comparison of blowdown methods. Upper chart shows conditions possible with a high-pressure boiler; below, with low-pressure boilers

BLOWING DOWN a boiler to maintain proper concentration of boiler water is an essential part of efficient plant operations. Inattention to its importance can often lead to very serious damage to turbine blades, engines, pumps, superheater tubes, and steam lines as a result of wet steam and deposits.

As steam is generated within a boiler, the total dissolved solids present in the entering feedwater will concentrate, and if allowed to exceed certain maximum limits, the surface tension of the boiler water may be so altered that priming and foaming occur and some of the concentrated salines carry-over with the steam. The American Boiler Manufacturers Association sets forth certain limits for total dissolved solids in boiler water (table p. 62) in combination with boiler pressures, although sometimes silica content of the boiler water, particularly for boiler pressures above 600 psig, is the controlling factor, rather than total dissolved solids.

In order to keep within these allowable limits, a certain quantity of the concentrated boiler water must be drained from the boiler drum. The quantity of blowdown can be figured by the following equation:

$$\text{Blowdown} = \frac{\text{Quantity of Make-up} \times \text{TDS in Make-Up}}{\text{Allowable Concentration}}$$

This hot blowdown water which is discharged to waste represents a substantial cost, because a fuel such as coal, oil, or gas has been expended in

*The Permutit Company, New York, N.Y.

Table shows allowable concentrations

Boiler Pressure (psig)	Allowable Concentration (ppm—current practice)
0– 300	3500
301– 450	3000
451– 600	2500
601– 750	2000
751– 900	1500
901–1000	1250
1001–1500	1000

heating the water. If the blowdown is removed from the boiler by the intermittent manual method, all of this heat in the water is lost. However, the continuous blowdown method provides for almost complete heat recovery.

The intermittent manual blowdown method consists of simply opening a pair of bottom blowdown valves for removing the sludge and, at the same time, reducing the dissolved solids concentration of the boiler water. At best, the concentration builds up between the successive intermittent blowdowns and then the concentration is suddenly dropped by the manual opening of the blowdown valves to discharge to waste a certain volume of boiler water equivalent to a predetermined number of inches of water in the boiler water gage glass.

A very irregular concentration of the boiler water results from this type of operation, as shown in Fig. 3, and keeping below the maximum concentration limit can only be accomplished by maintaining a very rigid and consistent blowdown schedule. With this method, the operator sometimes overlooks blowing down the boiler at the scheduled time, and the concentration may exceed the permissible limit to cause priming and foaming and the production of wet steam.

Why Continuous Blowdown?

Continuous blowdown provides an automatic means for maintaining the total dissolved solids in the boiler salines within the allowable limits, by continuously removing a small stream of water from the boiler. The concentration is kept constant (Fig. 4), and the wide fluctuations in boiler feedwater demand are eliminated Also, the savings realized from heat recovery quite often pay for the initial equipment investment in only a few months.

A continuous blowdown system may be classified as a low heat-level system, high heat-level system, or a combination of the two systems. Low heat-level systems transfer the heat of the blowdown into the feedwater ahead of the deaerating heater. High heat-level systems transfer the heat into the feedwater after the deaerating heater. The combined low and high-heat level systems transfer the heat to both places.

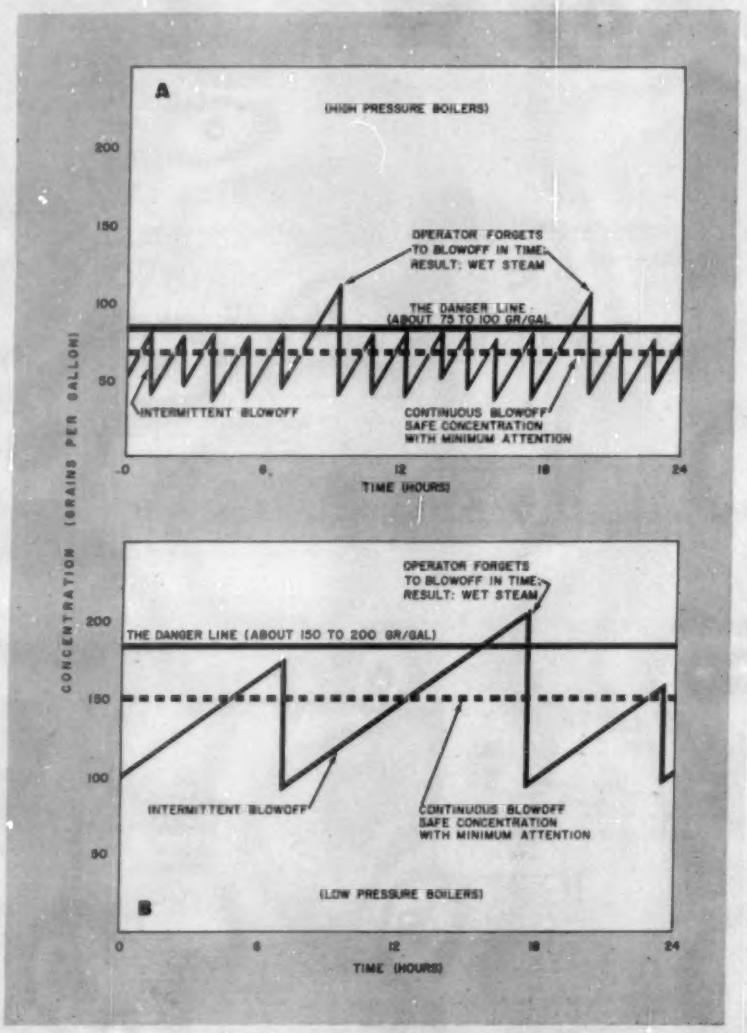
Which system to choose depends upon the particular heat balance diagram of the plant in question. If there is insufficient exhaust or low-pressure steam to heat the feedwater to the boiling point in the deaerating heater, and live or high-pressure steam must be added for this purpose, then the low heat-level system is indicated, because transferring the heat of the blowdown water to the feedwater entering the deaerating heater reduces the amount of live steam required. However, if there is an excess of exhaust steam which is wasted to atmosphere, the high heat-level system is preferable since it increases the temperature of the water leaving the deaerating heater, and thus reduces the amount of fuel needed in the boiler. The combination of low and high-heat level systems can be used in plants where there is an excess of exhaust steam during certain seasons of the year, but where supplementary live steam is needed during other seasons of the year.

The two principal types of continuous blowdown equipment are:

1. Non-Flash System
   a. Individual control; high, low, or high and low heat-level.
   b. Group Control; high, low or high and low heat-level.
2. Flash System
   a. Single-Stage Flash Tank; high or low heat-level.
   b. Two-Stage Flash Tank; high and low heat-level.

Non-Flash System

In a boiler plant where there are only one or two small capacity boilers with low boiler pressure, and the blowdown rate is small, the individual non-flash system for each boiler



Figs. 3 and 4. The graph shown at top illustrates non-flash, low heat level system with individual control. This system is usually preferred with one or two small boilers at low pressure. Same system is shown below except that blowdown from each boiler drum discharges through both a high and a low level heat exchanger

is usually preferred because it provides for individual control of each boiler. The blowdown from each boiler drum is discharged through either a single low heat-level heat exchanger and then to waste (Fig. 2), or through a high heat-level exchanger plus low heat-level exchanger and to waste (Fig. 2). Generally, the flow control valve is placed at the outlet of the low heat-level exchanger so that there will be no restrictions in the line between the boiler drum and the exchanger. If the flow control valve were located in the blowdown line ahead of the exchanger, the hot saturated blowdown water would flash as a result of a reduction in pressure across the valve, and rumbling and vibration would occur in the line and heat exchanger.

A rate-of-flow control box incorporating a high-pressure float-operated inlet valve and an adjustable, needle-valve orifice outlet can be used at the outlet of the heat exchanger to control the flow of blowdown instead of a flow-control valve. The flow-control box provides for a visual check by the operator as to whether the boiler is being blown down properly.

Control for Several Boilers

A more expensive arrangement for individual boiler blowdown control where there are several boilers, and space does not permit installing numerous heat exchangers, is a single low-level heat exchanger or single high level and low level exchangers having multiple streams so that each of the various blowdown lines will pass through the exchanger in a section separate from the other blowdown streams. Such a heat exchanger requires only one cooling water stream. A flow-control valve or rate-of-flow control box is installed in each of the blowdown lines at the low level heat exchanger outlet for individual boiler blowdown control.

Where there are several small capacity boilers and a non-flash system is preferred, it is sometimes too expensive to provide for an individual heat exchanger or exchangers for each boiler. The group control system can then be offered although it has the disadvantage of not providing for individual boiler control.

System Design

This system consists of a single low heat-level heat exchanger for the several boilers or a high heat-level exchanger and a low heat-level exchanger for the boilers. With this set-up, the flow-control valves are placed in the individual boiler blowoff lines ahead of the heat exchangers, and the various lines are joined to a common line leading to the exchanger. A gate valve should be installed in the outlet of the low heat-level exchanger to provide back pressure on the flow control valves for the purpose of minimizing any flashing that may occur across these valves as a result of pressure loss.

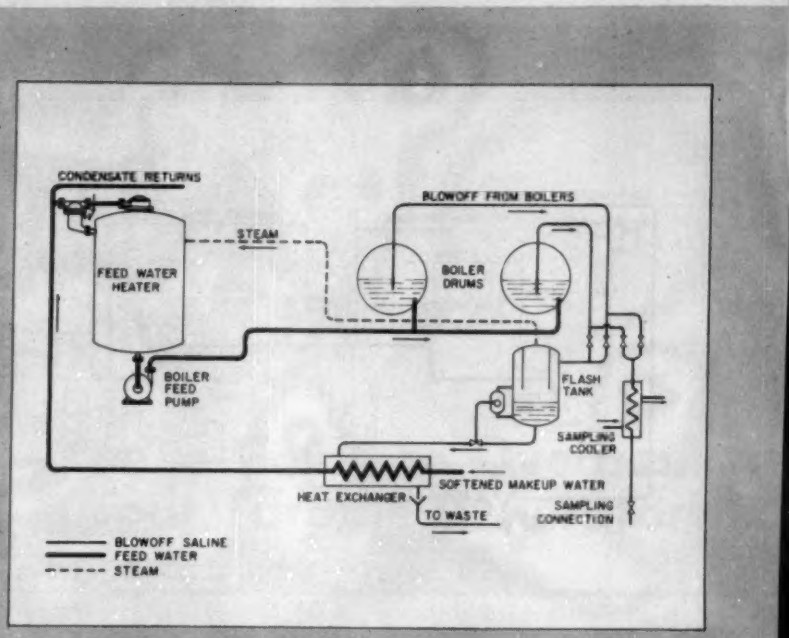


Fig. 5. Flash, low heat level system with group control; this type system is best for plants with substantial blowdown where flashed steam can be utilized

With the group control system, it is advisable to provide a sampling line running from each blowdown line to a sample cooler so that a check on concentration of the boiler water from each boiler can be made.

Flash System

For larger capacity boiler plants where the blowdown quantity is substantial and where flashed steam can be used in a deaerating heater or for process heating or other purposes, the flash system is recommended. This type of continuous blowdown system allows the blowdown water to pass first into a flash tank operated at a pressure below boiler pressure. The reduction in pressure causes a portion of the blowdown water to flash into steam and this flashed steam is then delivered to either a deaerating heater or some other steam system. The residual or unflashed portion of the blowdown water is then passed through a heat exchanger where further heat recovery is accomplished before the blowdown water is discharged to waste.

If the flashed steam is delivered to a low-pressure deaerating heater, this is referred to as a low heat-level flash system (Fig. 5). On the other hand, if the boiler pressure is high enough to permit flashing the blowdown water at a relatively high pressure, so that the steam can be delivered to a medium or high-pressure steam line or steam system, such an arrangement is referred to as a high heat-level flash system.

With the single-stage flash tank system, the individual blowdown lines from all of the boilers are connected into a blowdown manifold attached to the flash tank. The individual flow-control valves are located in the various blowdown lines at the inlets to the manifold so that the flashing that occurs as the steam passes through the valves is introduced immediately into the flash tank.

How Flash Tank Works

The blowdown water enters the flash tank tangentially, which gives a centrifugal motion of steam and water around the outside of the internal circular baffle (see Fig. 1). The centrifugal motion causes the heavier water to be separated from the steam with the water impinging along the sides of the flash tank and running downward. Most of the water is separated from the steam in this manner, but there is a further and final degree of separation accomplished when the steam changes direction 180 deg around the lower edge of the baffle. As the steam changes direction and flows upward toward the outlet at the top, the centrifugal motion is dissipated and the heavier droplets of moisture will continue downward to the water surface. Hence, the light and purified steam discharging

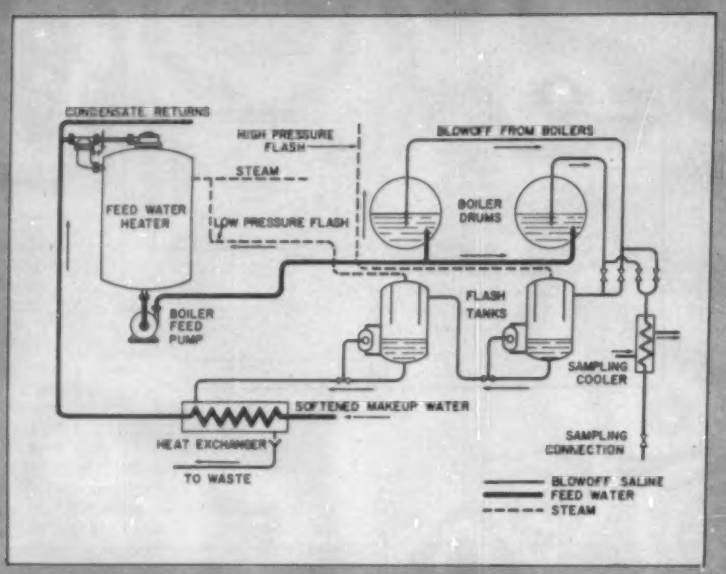


Fig. 6. This system is similar to that shown in Fig. 5, but is employed where boiler pressure is high. Blowdown is flashed through two-stage tank system

at the top of the tank is free from moisture.

The unflashed portion of the blowdown water discharging from the bottom of the flash tank is controlled by a direct-operated drainer valve which maintains a constant water level in the tank. This residual blowdown passes through a heat exchanger where heat recovery to within 10 F to 20 F of the cooling water inlet temperature is accomplished by the circulation of cooling water through the exchanger. The cooled blowdown water is then discharged to waste.

Flash Steam Relief

A relief valve is mounted on the flash tank to relieve the maximum amount of flashed steam that could result if the flow-control valves were left wide open. The relief valve is usually set at the flash tank design pressure.

Where the quantity of blowdown is considerable and the boiler pressure is high, a two-stage flash tank system is often employed (Fig. 6). The blowdown water from the boiler drums is discharged into a first-stage flash tank operating at an intermediate steam pressure, and the residual blowdown is then delivered to a second-stage flash tank where steam is flashed at a lower pressure. The residual blowdown from the second-stage tank is passed through a heat exchanger and then to waste.

The drainer control valve on the first-stage tank should be a remotely-operated valve with the float cage on the first-stage tank and the valve, itself, located immediately adjacent to the inlet to the second-stage tank. Since the residual blowoff passing through this valve will be hot saturated water, there will be flashing as it passes through the valve, and by locating it at the inlet to the second-stage flash tank, the mixture of blowdown water and flashed steam are introduced directly into the second-stage tank, ths avoiding any rumbling and vibration in the line between the two tanks.

The two-stage flash tank system can be considered to be a high-and-low heat level arrangement with the flashed steam from the first-stage flash tank passing to an intermediate steam pressure line or steam system, and the flashed steam from the second-stage flash tank being delivered to the deaerating heater.

The flash system has the following advantages over a non-flash system:

a. Heat recovery from that quantity of blowdown water flashed into steam is complete, whereas heat recovery from an equal quantity of blowdown water that passes through only a heat exchanger is not so complete because of the terminal temperature difference loss of the heat exchanger;
b. the flashed steam is recovered in the system as condensate which reduces the quantity of make-up water required;
c. the amount of blowoff to the heat exchanger is reduced by the quantity of flashed steam, therefore permitting a smaller heat exchanger.

However, a flash system sometimes is not practical where the blowdown quantity is small and the resulting quantity of flashed steam is quite small. A study of the cost of the two systems versus savings in heat recovery usually dictates which system is desired.

Conclusions

High boiler pressures and high evaporation rates have greatly magnified the importance of maintaining the concentration of boiler salines within certain allowable limits. Also as plant operating and maintenance costs continue to rise, greater emphasis must be placed upon the value of recovering heat from boiler blowdown.

Continuous blowdown equipment provides not only an automatic means of maintaining boiler-water concentrations within certain allowable limits, but also a reduction in plant operating costs. Along with savings in heat recovery, the reduction in operating costs includes less wear and tear on main blowdown valves, less strain on boiler metal as a result of more uniform demand of feedwater to the boiler, no scaling of condensate lines and heat transfer surfaces as a result of deposits from carryover.

The initial investment in a blowdown system is quite often recovered in a few months from heat savings realized by the installation of blowdown equipment.

Therefore, those companies who are still using the intermittent manual blowdown method should give careful consideration to the many advantages of a continuous blowdown system.

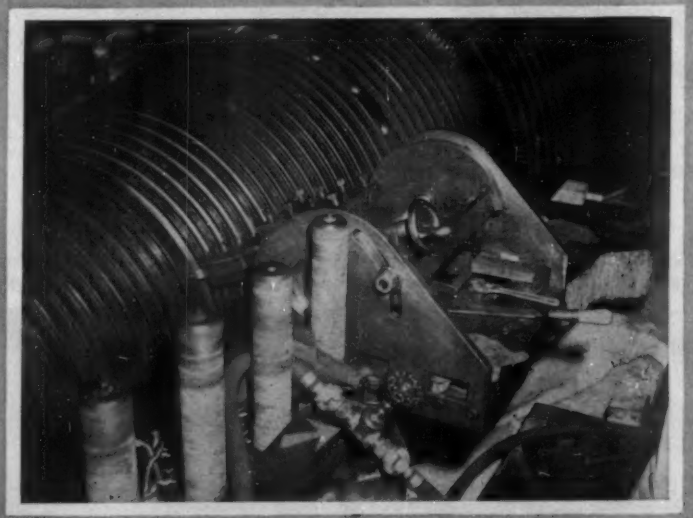
Paper Mill to Have 40,000-kw Turbine

LARGEST steam turbine-generator in the paper industry will be built for the International Paper Co. by the General Electric Co. The 40,000-kw single automatic-extraction condensing unit will be installed in the paper company's new $20,000,000 newsprint mill being built adjacent to its present Southern Kraft Division mill in Mobile, Alabama.

The turbine for this giant unit will operate at a throttle pressure of 1450 psi at 1000 F. This is the highest steam pressure and temperature of any turbine presently being used in the paper industry. Shipment is scheduled for the middle of 1956.

So—You're Going to Overhaul Your Turbine Generator!

This is the seventh article in a series describing the scheduled overhaul of a 25,000-kw turbine generator at U. S. Steel Corp.'s South Works in Chicago. A list of past and future articles is given below. When all the articles have been published, we plan to reprint the whole series. To reserve a copy of the reprint, write to the Editor.

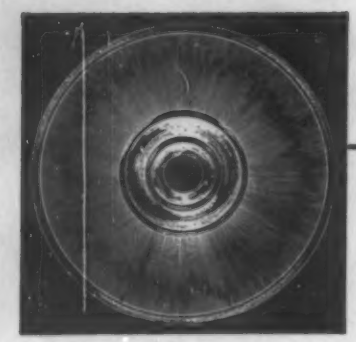


VII. MACHINING TURBINE SPINDLE

To accommodate new type blading, some machining of the turbine spindle was necessary. This article shows how it was done

Machining spindle. The tool holder is mounted on turbine casing flange and the spindle is rotated by an air motor

I. Preview of whole series. II. Planning . . . Preparation . . . Preliminary work. III. Removing turbine cover and spindle. IV. Turning turbine cover. V. Reblading. VI. Metallizing eroded shaft. VII. Machining turbine spindle. VIII. Checking clearances after reassembly. IX. Work on generator. X. Re-aligning turbine spindle. XI. Miscellaneous work. XII. Safety and time-saving ideas.



VII. Machining Turbine Spindle

WHEN THE OLD blades had been removed, some machining of the spindle was necessary to accommodate the new type blading. This work was carried out with the spindle resting in position in the turbine bearings. The cutting tool was held in a compound tool holder adapted for bolting to any part of the casing flange.

To rotate the spindle for machining, a gear train, driven by a compressed air motor, was mounted on the shaft as shown in Fig. 2. Another view of the same gear train is shown in Fig. 1.

With this driving arrangement the spindle could be rotated at approximately 15 rpm, and a valve on the air supply hose, seen in Fig. 6, enabled the operator to start and stop the spindle as required during the machining operation.

The air motor developed only 2 hp and even with the mechanical advantage of the gear train it was not powerful enough to turn the heavy spindle unless friction was reduced. This was done by pumping heavy oil underneath the shaft at each bearing, so that the spindle would float on an oil film. The procedure is shown in Fig. 4. Once the spindle had been supported on the oil film, it could be rotated easily. During the machining operation the oil gradually leaked out from beneath the shaft, allowing the spindle to settle down into the bearings. To maintain oil pressure, and keep the shaft floating, the oil had to be repumped about once every half hour.

Immediately after the machining operation had been completed, the spindle was lifted out of the casing, and all metal turnings and dust were carefully removed from both spindle and casing.

To eliminate end play while the spindle was rotating, so that machining would be accurate, two small rollers were mounted in brackets on the turbine flanges so that they were in contact with each side of the dummy piston. One of these rollers in position is shown in Fig. 5.

Rotating Spindle Alone

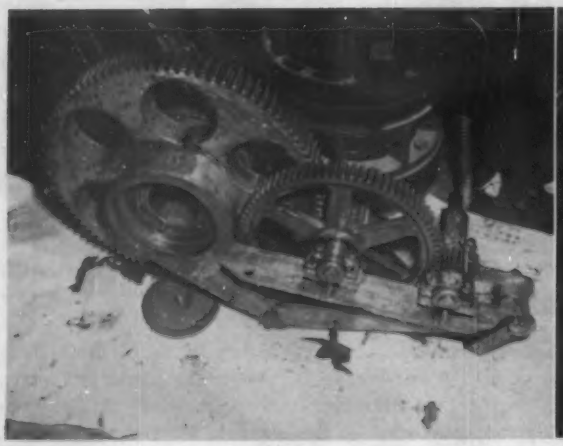
For certain operations, such as sand-blasting the spindle blading and metallizing the shaft, where there would be danger of metal and dust particles damaging the turbine, the spindle had to be taken out of the turbine and rotated by itself in the maintenance bay.

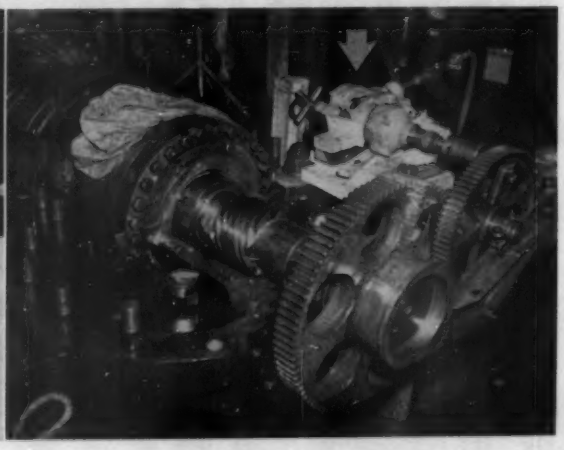
Figures 7 and 8 show how the shaft bearings were supported. Angle iron supports on blocking were positioned to support the bearing housing side pads. The turning gear shown in Fig. 1 was then used to rotate the spindle.

Trimming Shrouding

The new blading was installed in sections, each section consisting of an assembly of five blades. It is customary to provide stock for finish machining of the blade shrouds after installation of the blade sections in the spindle. By machining the shrouds after blade assembly, the specified clearances are established. For this trimming operation, a lathe tool was mounted as shown in Figs. 9 and 10, the spindle being rotated by the turning gear shown in Fig. 1.

Figs. 1 and 2. Gear train and air motor used to rotate spindle for machining operation. Fig. 2. (Right) Shows assembly in position. Air motor indicated by arrow





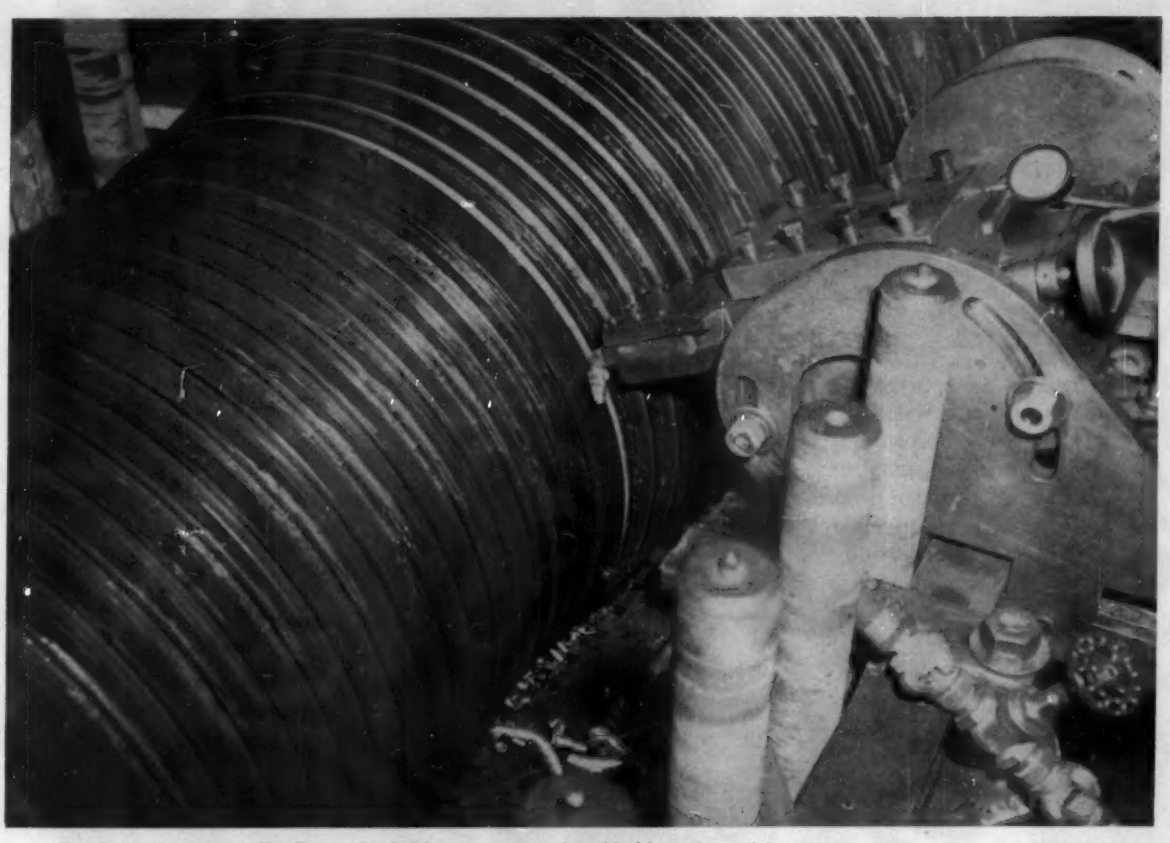


Fig. 3. Machining spindle. The tool is held in a compound tool holder adapted for use in any part of the casing flange. H-p cylinder studs seen in foreground

Fig. 4. Below. (Left) Pumping oil to bearings to lift spindle on oil film and make rotation easy. Fig. 5. (Right) Arrow indicates roller used to eliminate end play

Fig. 6. Operator could start and stop spindle rotation during machining by means of a valve on the air supply hose as shown

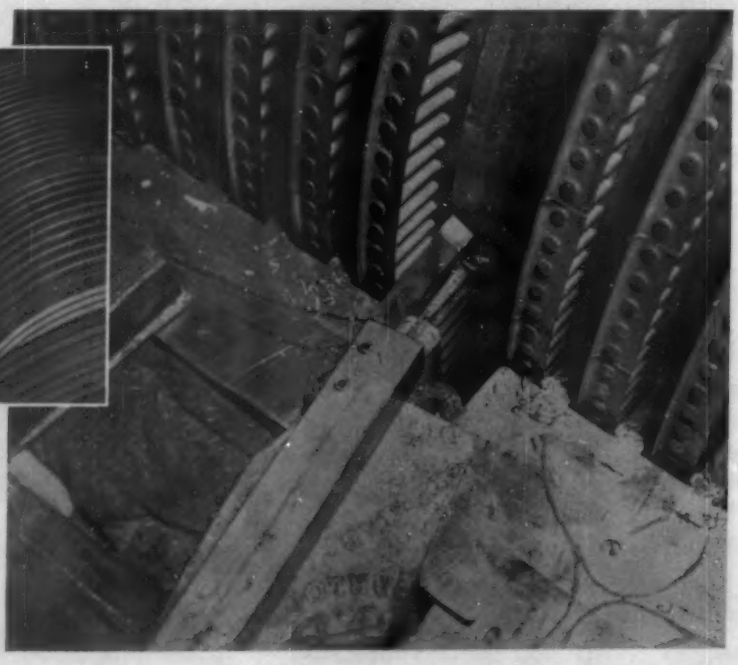
Fig. 7. Angle iron supports on blocking for taking weight of spindle when rotated by itself outside the turbine casing

When all these articles have been published, the series will be reprinted. Here are some ways the reprints can be used:

1. To train young engineers.
2. To brief new men before an overhaul.
3. To show management why so much time is needed for an overhaul.
4. To illustrate parts when discussing any turbine generator problem.

If you want one or more reprints write to the Editor.

Fig. 8. Bearing side pad resting on angle iron support. Spindle was rotated by air motor and gear shown in Fig. 1



Figs. 9 and 10. Above and right. Trimming shrouding on new blading. After machining, spindle was removed and whole machine thoroughly cleaned

Repair Hose Damage ... Save Money

IF YOU HAVE BEEN replacing rubber hose simply because it has been damaged by tears, rips, abrasions, or burns on the outer covering, you are throwing away money needlessly. A new material recently developed for the Navy makes it possible to repair such damage simply and permanently without special equipment or skills. An article in a recent issue of the Navy's *Bureau of Ships Journal* describes a method by which these repairs may be easily effected.

The proper material to use for hose repairs is the sealing compound known as General Stores Stock No. 52-C-3265[*]. The repair work can be easily done anywhere by following the simple steps described below:

1. The hose cover area to be repaired is first scrubbed clean with a wire brush or an electric buffer. All loose rubber should be trimmed away with a knife. All parts must be clean and dry before proceeding (Fig. 1).

Proper Preparation Is Important

2. The fabric, or base material of the hose, should then be roughened and the rubber cover around the hole tapered outward from the edge for at least one-half inch. This tapering may be done with a grindstone or coarse sandpaper cemented for convenience to a block of wood. Figure 2 illustrates this step completed.

3. Next, the compound is prepared. It is important to do this just prior to use since the mixture is a self-curing compound and cannot be used a second time. It is packaged in a two-part can specially designed to blend the two ingredients. The lower (larger) section of the can contains the base compound and the upper (smaller) section contains the less viscous accelerator. The accelerator and base compound should be thoroughly mixed in the bottom part of the can with a spatula or putty knife until uniform. The two materials are proportioned so that a self-curing or "set-up" material will result four to six hours, depending on temperature, after blending. This delayed set-up gives the repair man ample time to use the compound.

4. The mixture is then spread with a putty knife or spatula over the hose area to be repaired. The compound should be worked into the hose fabric and the edge of the cover to eliminate air bubbles, and built up to a level slightly higher than the thickness of the hose cover. If a smooth finish repair surface is required, a thin sheet of aluminum foil may be placed over the repair. To avoid adhesion, the foil should first be lightly coated with silicone grease or soap. Figures 3 and 4 illustrate the application of the compound.

Tape Wrapping Is Added Protection

5. At least two layers of friction tape are then wrapped over the repaired area. This wrapping should extend about 1½ in. on either side of the repair (Fig. 5).

6. The tape must be left on the hose for at least 48 hours to allow time for the repair compound to cure. However, if the tape is left on permanently, it will give added protection to scuffing and abrasion. Where the aluminum foil is used, a smooth hose cover surface will be obtained which does not show a tape impression.

A major cause of hose failure results from deterioration through unprotected cut ends. When a hose end has been cut off, the exposed reinforcing wires or fabric are subject to water attack. The resulting deterioration can spread fairly rapidly into the body of the hose with a consequent "blowout." It is recommended therefore that freshly-cut bare hose ends be treated promptly by a procedure similar to that described above for repairing cover breaks.

* *Editor's Note:* **This material is a proprietary polysulfide rubber base compound which is available commercially in pints, quarts, gallons, and 5-gallon pails. Name of manufacturer on request; write the Editor, or jot HOSE REPAIR on post card elsewhere in this issue.**

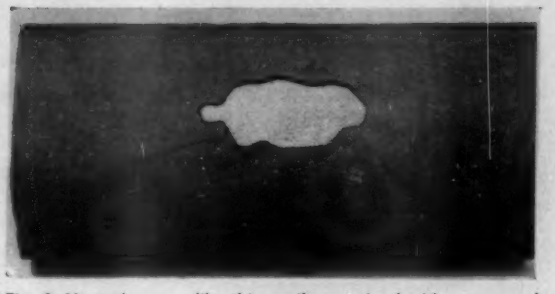


Fig. 1. Hose damage like this easily repaired with compound

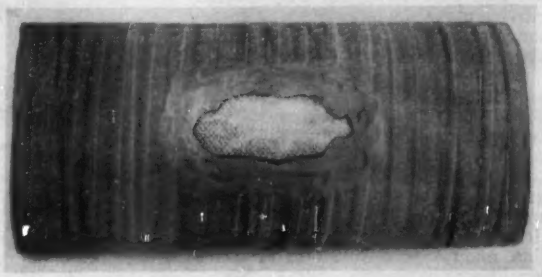


Fig. 2. After cleaning area, first step is tapering hole edge

Fig. 3. Second step is application of compound with spatula

Fig. 4. Fill hole trifle high, work out all the air bubbles

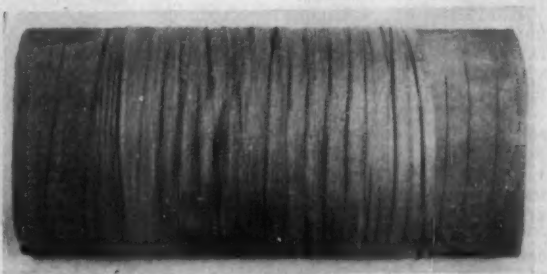


Fig. 5. Final taping overlaps repaired area about 1½ inches

Coy Connie's Cold War

Hurricane Connie conducted a war of nerves off the East Coast for about one week. She quickly scrubbed herself out when she romped ashore, however, and did little damage. Utilities were on guard because of their troubles with Hazel ('54), but had no big crises

AFTER DAWDLING about in the Atlantic for about a week, a big wind called Connie turned toward the East Coast of the United States. The populace there remembered only too well what happened last year in October when another hurricane, Hazel, came to call. Hazel just about wrecked everything. So they began moving movables indoors, tying down the immovables, and making storm plans based on recent experience.

Utilities especially recalled Hazel and the lessons she taught them. Last year, trouble trucks ran out of gas because they could not be refueled at blacked-out gasoline stations. This time they had storage tanks above ground at strategic locations and were not dependent on electrically driven pumps. Last year, supplies for line maintenance ran out in some localities; this year they were brought in ahead of time on the extra trouble trucks borrowed (with crews) from areas out of the storm's path.

In the case of Virginia Electric Power Co.'s Williamsburg facility, where one of POWER ENGINEERING'S editors out-patienced Connie with the local manager and line crews, eight extra men were brought in from Buena Vista and eight from Harrisburg in the western part of the state. Two extra trucks were also borrowed to meet the expected emergency. It was up to the local manager, L. L. Bond, to find accommodations for this extra help.

Connie's eye was to pass over the top of Williamsburg late in the evening, but conflicting radio, short wave and telephone reports put her in so many places at one time that anyone's guess was about as reliable. Rain provided most of the trouble; radio commentators provided most of the rest. Connie battered the tidewater area quite a bit with high tides and blew a few roofs off, but she lost force so quickly that Williamsburg never knew when she passed (if she did).

Suddenly, Connie was no more. Her press agentry far exceeded her acting ability. She blew out to sea, and everyone went to bed.

Elizabeth City, N. C., was reported hard hit, with power off and floods raging through the city. An editorial visit, however, found everything quiet and running normally. Some water from the high tides flooded some of the lower streets, but the power failure had occurred the previous day when a circuit breaker malfunctioned — before the hurricane arrived.

Total damage on the entire coast came to about $15-million, and most of this was due to water on the shore. But the utilities had their guard up.

Fig. 1. Elizabeth City, N. C. was visited by the Panquotank River when Connie hit

Fig. 2. Messrs. Parker (left) and Bond try to find Connie. Williamsburg was passed over lightly; no trouble calls

Fig. 3. Elizabeth City's Mr. Luther was ready for Connie, but his only trouble was a faulty breaker and the high tides

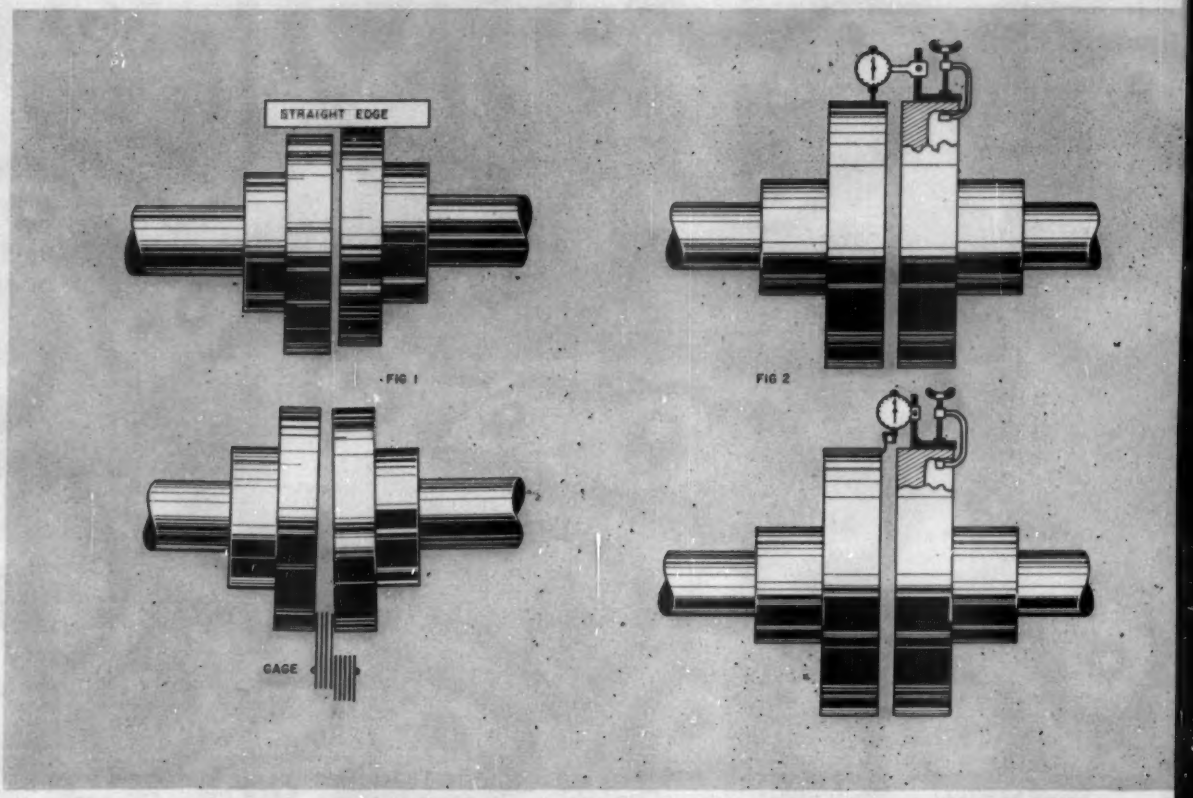


Fig. 1. Parallelism of coupling halves is important; alignment check with a straight-edge and feeler gage

Fig. 2. Most accurate way to check coupling flange alignment—use dial indicator to check parallelism

Use of Limited End-Float Couplings With Centrifugal Pumps

Mechanical couplings for centrifugal pumps are usually foolproof devices requiring little care or attention. This does not mean they can be overlooked entirely — here's how to care for them

By T. W. EDWARDS *

IT IS OF SIGNIFICANCE that of all the troubles that plague centrifugal pump operators, about 75 per cent of the mechanical difficulties can be traced to couplings and their alignment. Therefore, if an operator can effectively minimize this source of potential trouble, he will go a long way toward making life easier. Frequently, it is not apparent that the particular mechanical difficulty encountered is due to the coupling. Chronic bearing failures, for instance, are sometimes blamed upon a host of things before someone thinks to take a look at the couplings; recurrent shaft breakage falls into the same category.

Coupling misalignment can cause a high overload on bearings adjacent to it. This can cause pump line bearing as well as motor bearing failures. Severe misalignment causes reversal of shaft stresses, hastening fatigue failures in the shaft. If improperly set up, a flexible coupling can lock and transmit thrust, severely overloading thrust bearings and shortening their life. In some cases, this can impose a thrust on bearings not designed for this loading, causing rapid failure.

While this article will, in the main, deal with the use of so-called limited end-float couplings, the reasons for their use, and the principles upon which they function, it would appear advantageous to dwell for a moment on the subject of coupling alignment in general.

Basically, there are two ways to set flexible couplings in proper alignment. One is but a refinement of the other.

Through the use of a straight-edge and feeler gage, parallelism of faces and outside diameters can be accomplished. See Fig. 1.

Place a straight-edge across the top and sides of the coupling and, at the same time, check the faces of the coupling halves by means of a tapered thickness gage or feeler gage to see that they are parallel. For all checks of alignment, including that for parallelism of the coupling faces, both shafts should be kept pressed hard over to one side.

When the peripheries of the coupling halves are true circles of the same diameter and the faces are flat, exact alignment exists when the distance between the faces is the same at all points, and a straight edge will lie squarely across the rims at any point. If the faces are not parallel, the thickness gage or feelers will

*Application Engineer, Worthington Corporation

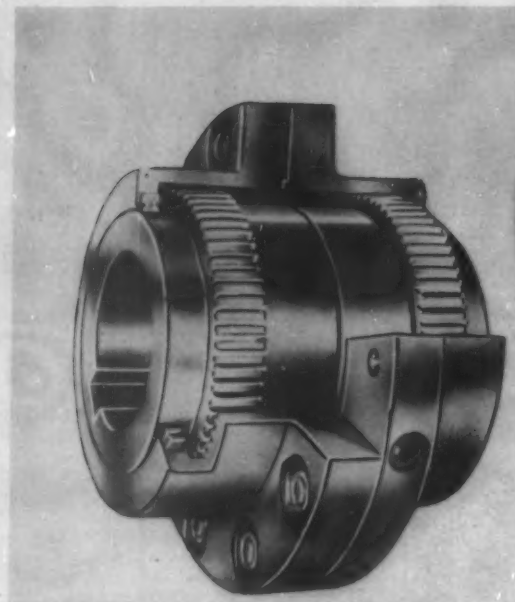


FIG 3

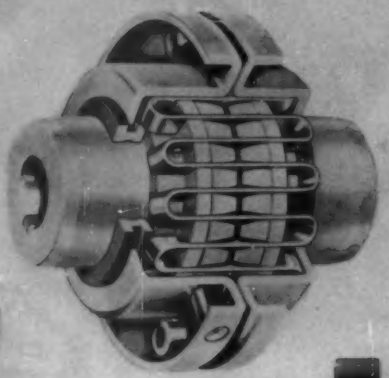


FIG 4

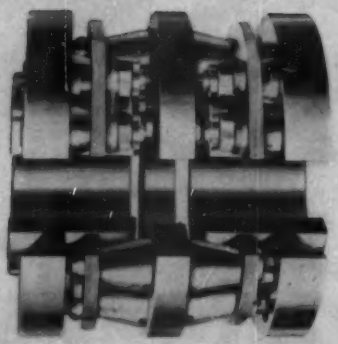


FIG 5

Fig. 3. Gear-type coupling; meshing gear teeth should be free to slide (Photo courtesy Waldron Corp.)

Fig. 4. (Top) Grid-type coupling; like the gear type, it needs lubrication. Fig. 5 (Lower) Disk-type coupling

show a variation at different points. If one coupling is higher than the other, the amount may be determined by the straight-edge and feeler gages.

Sometimes coupling halves are not true circles and not identical in diameter. In checking trueness of either coupling half, revolve it, holding the other coupling half stationary, and check the alignment at each quarter turn. Next, revolve and check alignment of the coupling half previously held stationary. A variation within manufacturing limits may be found in either of the coupling halves and proper allowance for this must be made when aligning the unit.

Instead of using a straight edge and feeler gage, dial indicators may be used to align the coupling halves (see Fig. 2). The indicator is bolted to the pump half of the coupling and used to check both radial and axial alignment. With the button resting on the other coupling periphery, set the dial indicator at zero and chalk mark the coupling half at the point where the button rests. For any check (top, bottom, or sides), rotate both shafts by the same amount, i.e., all readings on the dial indicator must be made with its button on the chalkmark. The dial readings will indicate whether the driver has to be raised or lowered or moved to either side. After any movement, check the coupling faces to see that they remain parallel to one another.

If the dial indicator at the starting point is set to zero, and the diametrically opposite reading at the bottom or sides show a plus or minus 0.006 in., the driver has to be raised or lowered by shimming, or moved to one side or the other by one half the amount of this reading.

Use of Dial Indicator

When an extension coupling is used, a dial indicator should be employed for checking alignment. The extension pieces between the coupling halves should be removed, exposing the coupling hubs. Using the coupling nut on the end of the shaft, clamp a suitable extension arm or bracket sufficiently long to extend across the space between the coupling hubs.

The dial test indicator is mounted on this arm and alignment checked both for concentricity of the hub diameters and parallelism of the hub faces. Changing the arm from one hub to the other provides an additional check.

In many designs of flexible couplings, the necessity of proper coupling lubrication is of equal importance to proper alignment. Designs which depend upon the sliding action of gears, chains, or grids must be properly lubricated or their flexibility may become impaired or lost entirely. For instance, if a gear-type coupling is allowed to run dry, the gear teeth, when loaded, may fail to function as sliding fits. Under these conditions, the coupling is no longer flexible and becomes locked. Changes in alignment due to thermal expansion, radially or longitudinally, will be transmitted through the coupling to the driver. This condition imposes abnormal loads on both pump and driver bearings. For example, in the case of a centrifugal boiler feed pump operating at an elevated temperature, the coupling, if properly aligned when hot, may be as much as 0.005 in. out of alignment when cold. If, in this case, the pump is started cold and then brought up to temperature while running, the coupling will fail to adjust itself to take care of this casing expansion and 0.005 in. of parallel misalignment will occur.

Thermal expansion will also occur in the pump shaft, and the distance between coupling faces will tend to decrease. If, due to lack of lubricant, these faces cannot come together, additional thrust loads may be imposed upon either or both the pump thrust bearing or the motor thrust bearing. In fact, the thrust bearings can operate in direct opposition to each other. This will, of course, cause premature thrust bearing failures.

It will be obvious, therefore, that

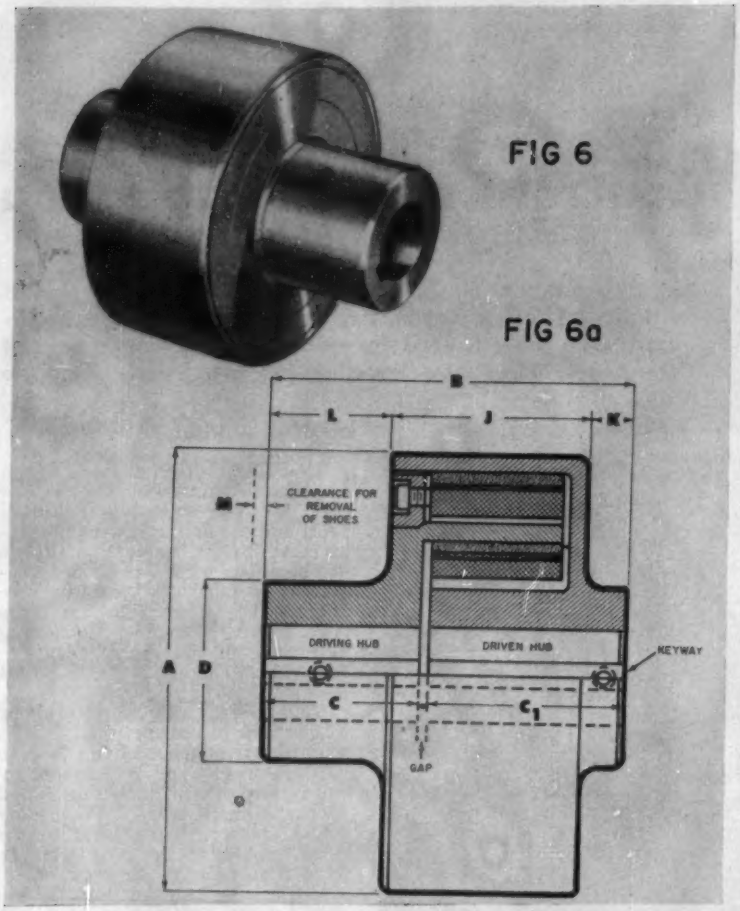


Fig. 6. Over-riding type of coupling; does not engage until driven hub reaches predetermined speed. Motor rotor centers itself before engagement is locked

improper lubrication or lack of lubricant in certain types of flexible couplings can cause serious pump troubles through lack of coupling flexibility.

Why End-Float Couplings

With this background, let us consider limited end-float couplings. The need for limited end-float couplings arises from the fact that more and more high-speed motors, such as commonly used for boiler feed pump drives, are being provided with sleeve line bearings and without thrust bearings. These motors are designed to operate at their magnetic center. When at rest, the location of the rotor is undetermined and may be anywhere within the float allowed. This may be as much as 0.50 in. Upon starting, however, the rotor will locate itself in its magnetic center if free to do so. Since the centering force developed within the motor which produces this self-location is relatively low, any external thrust which may be imposed can easily hold the rotor away from its magnetic center. If this force is great enough (and a very small amount is required) the rotor may be forced hard over against its sleeve bearing shoulders and made to run there continuously. Since these sleeve bearing shoulders are not designed as thrust bearings, premature failure will result. The limited end-float coupling was developed, therefore, to prevent this condition by imposing positive limits of motor rotor end-float, with the pump thrust bearing as a reference.

First, let us look at the gear, or splined type (see Fig. 3). In this type, flexibility is achieved through the use of two external gears, one on each shaft. They are joined together by means of a sleeve which is splined with two sets of internal gear teeth. Flexibility is achieved by the relative motion of the meshing teeth in the two gear sets. Axial motion is limited by contact between the hubs themselves in one extreme position and through contact between the ends of the sleeve and the outside faces of the external gears in the other extreme. Since these two extremes usually exceed by far the allowable end float of the motor rotor, it can be seen that there is danger of contact within the motor. To limit this float the following steps are taken:

1. The maximum spread between coupling hubs is ascertained, and with the coupling so set, the motor stator is located to just prevent internal contact.
2. The minimum distance between coupling hubs is then set by means of a button on one shaft end to just prevent internal contact within the motor in the other extreme.

This can be done whether the coupling is of the mill type, floating shaft type, or spacer type.

Grid and Disk Types

The grid-type coupling (Fig. 4) is very similar in application except that the sleeve with internal teeth is replaced by a sectionalized grid which is in itself flexible. The method of handling this application is the same, however, as for the gear type.

The flexible disk-type coupling (Fig. 5), however, is entirely different in its action. Here flexibility is achieved by the use of a lamination of thin discs fastened to both coupling hubs, alternately around its circumference, usually 90 degrees apart. In this case, axial strain in either direction is met with internal resistance within the coupling. This resistance increases as a function of strain. Therefore, if the coupling is properly applied and set, the force to drive the motor rotor hard over in either direction will probably be more than overcome by the internal resistance developed within the coupling itself. Extreme care must be taken, however, to be sure that the neutral position of the coupling coincides with the running center of the motor rotor, since thrust can be transmitted through this type of coupling at any time.

Over-riding Coupling

In the case of the so-called over-riding coupling (Fig. 6), it is usually sufficient to be sure that the coupling is designed with an engaging speed in excess of that speed at which the motor rotor locates itself at its magnetic center. In this manner, the rotor is free to locate itself before the coupling engages. When engaged, this type of coupling will transmit thrust; therefore, care must be taken to be sure that thermal expansion or any other change which will produce thrust forces will not move the motor rotor hard over in either direction.

In conclusion, it might be said that limited end-float couplings are designed to avoid imposing thrust loads on motor bearings not designed for that purpose. They do this by limiting motor rotor float within certain prescribed limits. The point of reference is the pump thrust bearing which is fixed. In any application care must be taken to ascertain the need for this safety feature and to be sure that it is provided where required.

How They Control Coal Dust at Joppa

Suppression of dust at all enclosed coal handling points was part of initial design of Joppa Station, Electric Energy, Inc. Actual operating experience showed need for additional coal dust control at outdoor points; here's how liquid dust control system does job

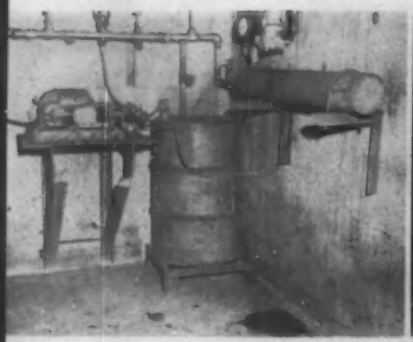
By C. B. SCHUDER *

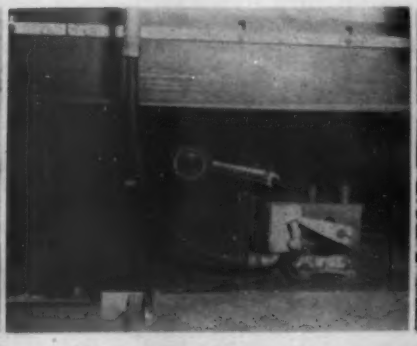
CONSTRUCTION of Joppa Steam Electric Station of Electric Energy, Inc. was started in February 1951, and the first unit went in service in April 1953. Today, six units are in operation, with a combined generation of 1,080,000 kilowatts. (See Joppa — Big Plant Fast, for More AEC Power, November 1952 issue; also Race of the Power Giants — Shawnee and Joppa, September 1954 issue)

The present load requires about 12,000 tons of coal per day. Grades vary from five-inch mine run down to −10 mesh dust and is delivered by rail from southern Illinois fields and by barge from Kentucky. The crusher house and conveying belts to the plant bunkers are designed to handle 1200 tons of coal per hour, all of which can be supplied from the rail side, or up to 800 tons per hour each from the river side or reclaim hoppers.

* Mechanical Engineer, Electric Energy, Inc.

Fig. 1. Crusher house and conveyors; all conveyors leaving crusher house are served by single, centrally-located liquid system with manually-controlled pump





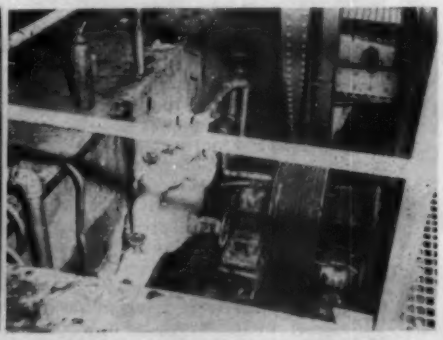


Fig. 2. (Left) Proportioning unit with positive displacement pump installed in reclaim pit injects small amount of wetting agent into water line to spray heads

Fig. 3. (Center) Belt switch, in conjunction with breaker switch, controls the operation of sprays; solenoid spray valves will not open unless both are closed

Fig. 4. (Right) Solenoid valve installation at car dumper. This system requires careful planning for maximum effectiveness in handling the unusual dust pattern

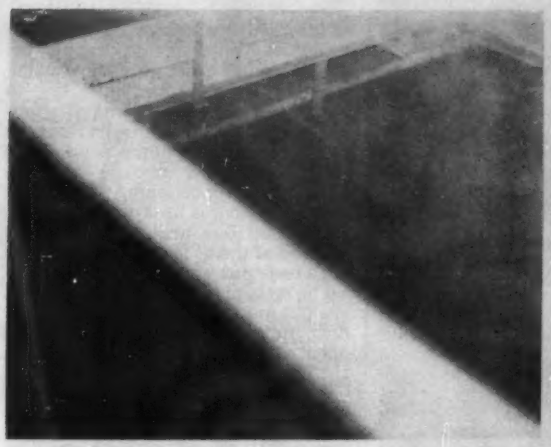


Fig. 5. How spray system controls dust is shown here and in next photo; bottom of conveyor to plant, control system off

Fig. 6. Here is same area shown in Fig. 5, but with liquid dust control system operating. Note absence of dust cloud

Initial plant design provided for dust removal at all enclosed loading and dumping points in the conveyor system by means of centrifugal dust separators which maintain a slight vacuum on the enclosures at these points. However, early operating experience indicated the necessity for more complete dust suppression in the conveyor system and also for some control at the barge unloader and car dumper.

A liquid dust-control system was chosen for this purpose because of its high effectiveness and unusual flexibility of application. In this type of system, a small quantity of wetting agent is automatically proportioned with water and sprayed on the coal at selected points in the system. Proper selection of the wetting agent and proportioning method, combined with a careful study of method and points of application, is necessary to insure complete coverage without adding unnecessary quantities of moisture to the coal. The total quantity of spray added is about two gallons per ton of coal.

The control areas selected at Joppa:

1. Barge unloader hopper
2. Car dumper and shakeout hopper
3. Conveyor from car dumper to crusher house
4. Conveyor from barge unloader to crusher house
5. Crusher area
6. Conveyor from crusher house to storage
7. Conveyors from reclaim pits to crusher house
8. Conveyors from crusher house to plant bunkers.

Two types of proportioning systems are used — the unit system and the central system. The unit system,

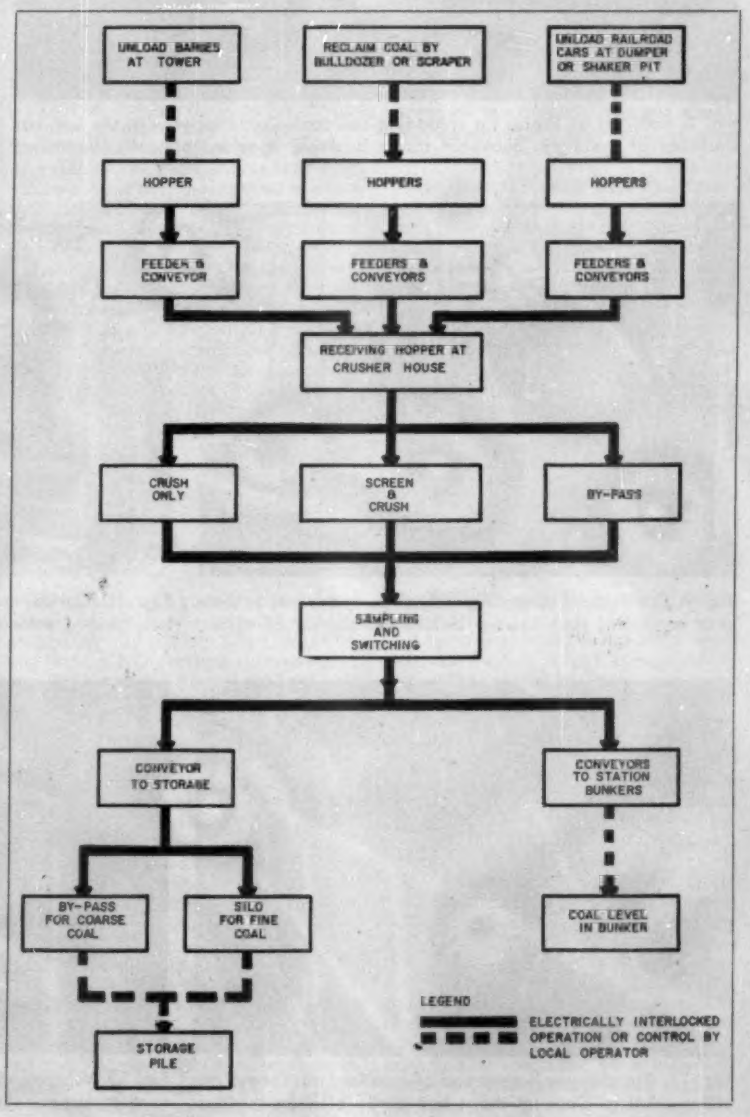


Fig. 7. Block diagram of coal handling system at Joppa. System handles about 12,000 tons of coal per day ranging from 5-in. mine run to −10 mesh dust

Fig. 8. Facilities at Joppa for unloading rail coal. Car dumper is at the left, car shakeout at the right. Shakeout spray is single header, manually controlled

as installed in the reclaim pits, uses a positive displacement pump, which injects a small amount of the wetting agent into the station water line to the sprays. At other points of application, where the central system is used, a centrifugal pump handles the water compound mixture from an automatic proportioning unit. This type of system is used where there is more than one area of application because of the necessity for maintaining a constant water-compound ratio.

The reclaim hopper conveyor sprays are automatically controlled by coal flow. Before the solenoid valves will open, allowing the spray to come on, the belt must be loaded and running. A microswitch in the breaker determines whether or not the conveyor is running and a switch under the belt, operated by the weight of the coal, indicates whether or not the belt is loaded.

The proportioning pumps operate in parallel with the spray water solenoids and are protected from loss of suction by a low level cut-off in the wetting compound tank. The only operating attention required is the occasional refilling of the compound tank.

Fig. 9. Car dumper operating with spray system off to show dust conditions that existed before installation of system

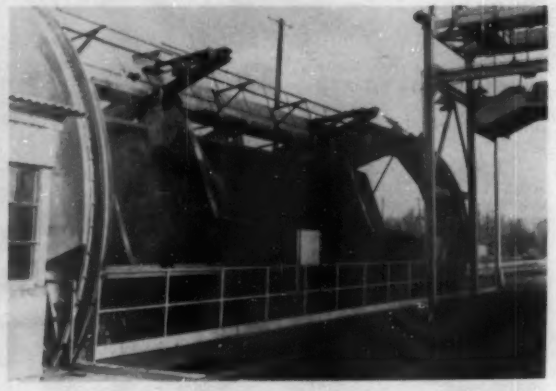


Fig. 10. Car dumper with spray system in operation. Dumper has rotated sufficiently (18 degrees) to start top sprays

Fig. 11. Car dumper is near end of rotation; top sprays are still operating. Close-up shows how spray blankets the coal

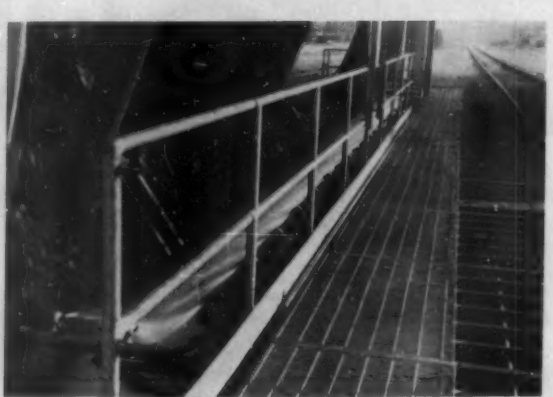


Fig. 12. When car has reached position 37 degrees from the vertical, hopper sprays (one on each side) go into operation

All conveyors leaving the crusher house utilize a single, centrally-located system. In this system, a manually-controlled pump handles the water compound mixture and the spray to the individual conveyor system is controlled by coal flow. The pump is protected from a no-flow condition by automatic recirculation and protected from loss of suction by a low-level cut-off in the proportioning tank.

Spray System

At the barge unloader, it was desirable to spray over the unloading hopper only during the interval that the coal was being dumped. The best indication of this period was found to be the position of the trolley, starting the sprays just as the bucket reached the correct position over the hopper and cutting them off as the bucket moved back out for another load. A switch in the trolley mechanism operates the solenoid valves to spray only during this period. The spray system is made up with a series of spray nozzles in two headers, each running full length of opposite sides of the hopper.

Application of the system at the car dumper was somewhat more detailed, due to the desirability of carrying part of the spray system with the rotating car and the necessity for careful timing of the sprays to obtain maximum effectiveness in handling the unusual dust pattern from the large hopper.

The spray system consists of three headers with nozzles sized, spaced, and directed for maximum effectiveness. One header is directly over the coal car and moves with the car during the dumping operation. Water is supplied through a swivel joint linkage. The other two headers run the full length of the hopper on each side and have their spray nozzles directed downward.

Hopper Sprays

All sprays are off as the dumper starts to rotate the car. After 18 deg of rotation, the sprays over the car come on, suppressing the dust that rises as the coal begins to slide and roll from the car. When the car reaches a position 37 deg from the vertical, and the cloud of dust is beginning to rise from the hopper, the hopper sprays come on. All three spray headers stay on until the car is empty and near extreme position of rotation. The sprays go off at this point and stay off until the next car is dumped. The sequential action of the solenoid spray valves is controlled by stationary switches, operated by extended lugs on the rotating dumper.

The spray system for the car shakeout is a single header, manually controlled.

The dust control system is used for all coals except those received wet and has been found very helpful in improving station cleanliness and general operating efficiency of the coal handling system.

This Inhibitor Cuts Corrosion in Heating System

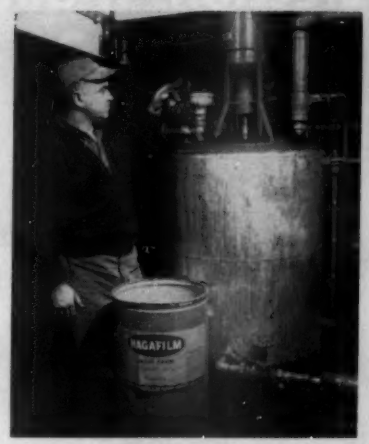
A HOME-MADE INSTALLATION for feeding corrosion inhibitor to a large heating boiler system is doing a professional job at the 100-building U. S. Bureau of Mines Explosives Research Laboratory in Bruceton, Pa., a suburb of Pittsburgh.

Blair Evans, operating engineer who designed and built the equipment, is pictured here feeding the film-forming amine Hagafilm into a 50-gal steel tank. The Hagafilm is mixed once every 24 hours with 218 F boiler feedwater in the tank, at the rate of two ounces per 100,000 lb of steam generated.

Insulated to keep the Hagafilm-water solution warm, the tank with removable top was fabricated from sheet steel in Bureau of Mines shops. Outside of the tank was coated first with paint to act as a moisture barrier, then with 2-in. magnesium rock insulation, then aluminum jacketing.

Within the tank, a ½-hp motor turns a stainless steel stirrer. White tape marks on a glass gage fixed to the side of the tank denote four even draw-outs of water-Hagafilm mixture within the 24-hour period. An eductor feeds the inhibitor into the suction of the boiler feed pump.

Vaporized within the boiler, the Hagafilm is then distributed with the steam and absorbed as a very thin non-wettable protective film on both ferrous and non-ferrous metals. This begins on the condensing surfaces of steam-heated equipment and extends throughout the condensate return system.



Evans, left, feeds corrosion inhibitor to 50-gal tank for introduction to feedwater at the Bureau of Mines Explosives Research Laboratory heating plant

Mr. Evans reports that this treatment has successfully reduced failures and maintenance, particularly of traps where corrosion products formerly interfered with efficient operation. Before Hagafilm was used, Mr. Evans said it was necessary to replace 2,500 ft of steel return lines every three years. Now there is no need for such replacement. A bonus benefit has been reduction of corrosion products carried into the four 259-hp, 150-psi boilers.

Power Production to Reach Trillion Kwh by 1964

POWER PRODUCTION in the United States in 1964 will amount to the staggering figure of 1,040,000,000,000 kwh, a 250 per cent increase over the 1954 rate of power used in this country, according to O. B. Falls, Jr., marketing manager for the Atomic Power Equipment Department of the G-E Atomic Products Division. He said that atomic energy offers the economical solution to this growing use of power, that in this country 65 per cent of new power generating plants added in 1980 will be atomic.

If low cost energy is to determine our very economic health, in the next 25 years conventional fuels must carry more load than reports indicate they are capable of handling. Hypothetical power systems of the future, in the main, can be supported only by a limitless new source of energy. Atomic energy represents this new source.

Atomic energy must be utilized to the fullest, said Falls, to provide power for:

A growing world population that will move up to 6 to 8 billion in the year 2050, nearly 2½ times the present world population.

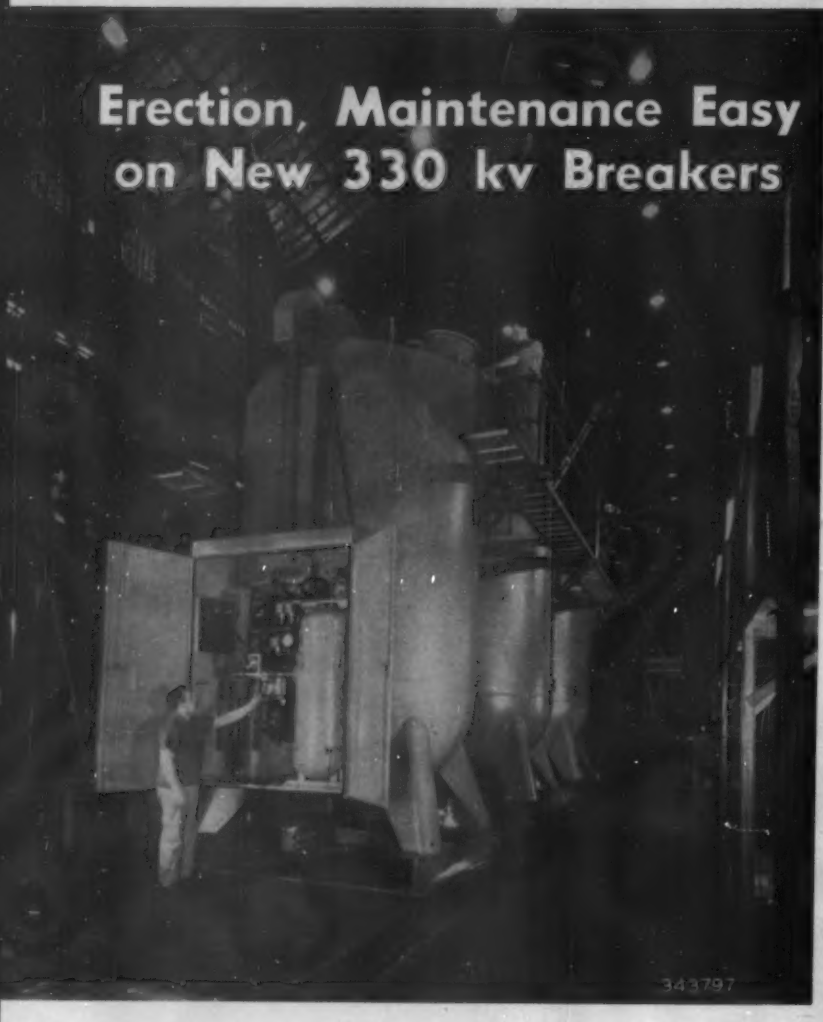
A better standard of living demanded by all peoples.

Increased production.

Gross national product is expected to reach $490 billion in 10 years, Falls said. This would be a 37 per cent increase over last year's $357,000,000,000.

At present, and probably until 1960, cost of building an atomic power-generating plant of the boiling reactor type is estimated at somewhere between $200 and $270 per kw, while the cost of building a conventionally-fueled steam plant of the same size would be about $175 per kw. By 1980, cost of a nuclear plant is expected to decrease to somewhere in the neighborhood of $145 to $165 per kw.

Erection, Maintenance Easy on New 330 kv Breakers



By G. J. EASLEY*

FIRST 25,000,000-kva oil circuit breakers ever built are now in operation at the Atomic Energy Commission project near Portsmouth, Ohio. These breakers meet the following specifications:

Voltage Rating	330 kv (350 kv maximum)
Impulse Level	1175 kv (1300 kv bushings)
Interrupting Capacity	25,000 mva or 44,000 amp. at 330 kv
Continuous Current Rating	1600 amperes (30°C Rise)
Momentary Current Rating	69,000 amperes
Four Second Current Rating	46,000 amperes
Interrupting Time	3 cycles
High Speed Reclosing Time	15 cycles

Each interrupter has a spring-driven oil pump which provides oil flow to each break for the interruption of line-charging currents without arc restriking. This pump also performs a flushing action immediately following each fault interruption, clearing out gases and other arc products to prepare the breaker for another operation a fraction of a second later.

In addition to its interrupting ability, the interrupter is easy to install, adjust, and maintain in the field. The contact adjustment of the multi-break arrangement is actually simpler than in smaller breakers. The only contact adjustment required is the height of the moving contact cross arm (Fig. 2) on its Micarta lift rod. Contact inspection is accomplished by removing grid blocks

*Power Circuit Breaker Engineering Switchgear Division, Westinghouse Electric Corporation, East Pittsburgh, Pennsylvania

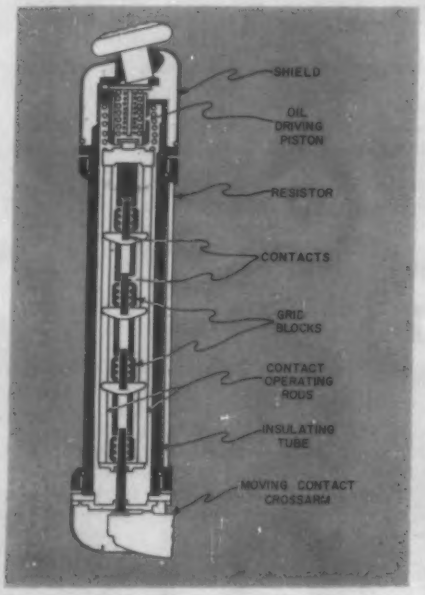


Fig. 1. Above left. Breakers use "watch case" design requiring less oil than cylindrical tanks and reducing their total weight

Figs. 2 and 3. Left. Views of interrupter unit showing multi-break arrangement and oil driving piston. With this type of interrupter, grid blocks can be removed for contact inspection without disturbing the alignment

as shown in Fig. 3. The contacts inside the interrupter tubes may be removed and replaced without disturbing alignment or adjustment. This is done by lowering the contact assembly from the interrupter tube as a unit through a trap door in the work platform.

The pneumatic operating mechanism was designed specially to handle the heavy three pole mechanical load of this 25,000 mva breaker. The mechanism may be adjusted for 15 cycle reclosing time, and the air reservoir contains enough compressed air for five breaker closing or reclosing operations. Since all three poles are tied together mechanically and operated by a single mechanism, there is no synchronizing adjustment problem between poles. A manual closing device for breaker maintenance is attached permanently to each mechanism. It may be disengaged easily to permit automatic operation.

Due to the size of this breaker and weight of the parts, several conveniences have been provided for field erection and maintenance. These and other pertinent features of the design are shown in Figs. 4 and 5. Not shown is the reservoir-type bumper in each pole unit lever system that permits tripping without oil in the tanks for maintenance purposes.

The new materials-handling and adjustment features have made it possible for an experienced crew to complete erection of a 330 kv breaker, in spite of its large size and rating, in the short time of one week.

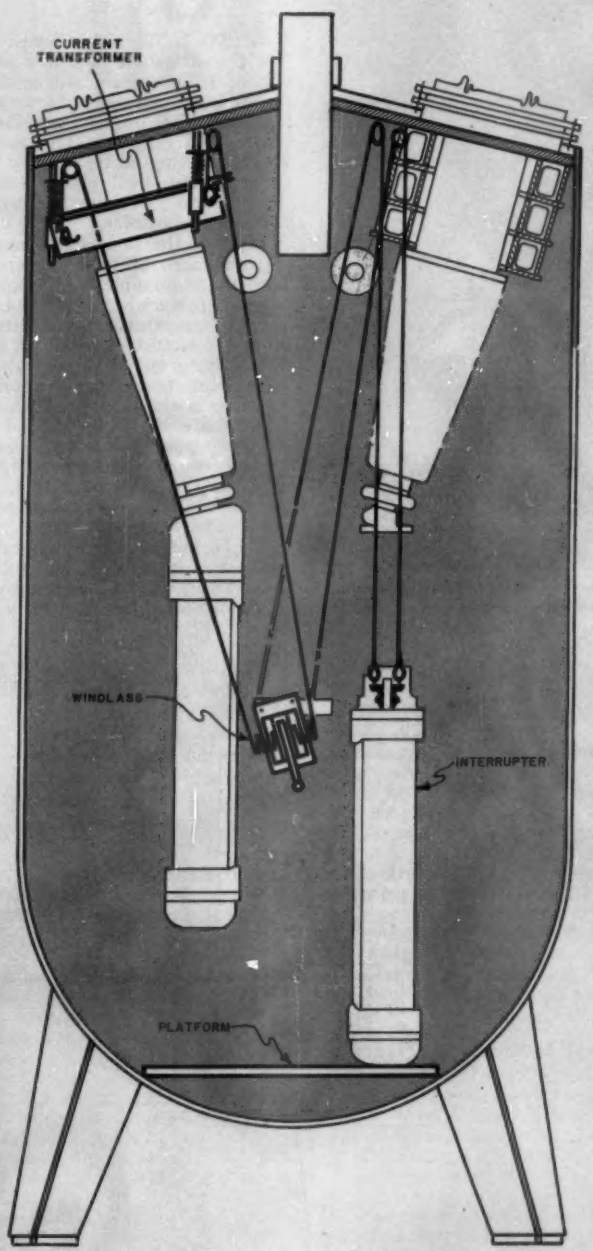


Fig. 4. Right. Section showing windlass for lifting interrupter, work platform and current transformers into position

Fig. 5. Below. Platform for working inside tank. Plumbline for aligning guides and rods also used to level tanks

What Makes an Ultrasonic Machine Tool Work?

Fig. 1. The ultrasonic machine tool looks much like other conventional machines

UP TO NOW we've heard about the ultrasonic tool as a painless way of drilling teeth, or a method of machining small pieces of very hard materials like tungsten carbide, sapphires, and ceramics. This new tool is now starting on its journey out of the specialist field into general industry, and you'll be hearing more about it in future.

Most of the remarkable engineering advances of recent years have been made possible by development of new materials to withstand increased temperatures, pressures and corrosion required by the new processes. Many of the new materials are so hard that machining by ordinary methods is almost impossible, and so these materials have created a demand for new ways to machine them. One of the methods that satisfies this need is the ultrasonic tool, whose principles and operation are explained here in simple terms.

The principle of the ultrasonic machine tool is very old and very simple. If you want to drill a hole in a piece of stone you can do it with a punch, some form of abrasive, and a hammer. You spread the abrasive over the stone and strike with the punch on the spot where you want the hole. The abrasive cuts the stone, and if you hit the punch often enough, and maintain the supply of abrasive, you will eventually, after a very long time drill yourself a hole. The ultrasonic tool employs the same principle, but now the hammer is a magnetostrictive transducer vibrating 27,000 times per second, the punch is mounted on a carefully designed cone resonant at this frequency, and the abrasive is a commercially available product such as boron carbide.

Operation

Figure 1 shows the equipment in operation. The transducer is mounted in a specially-designed support carried on the ram of a milling machine. Removable cutting tools are fixed to the end of the cone, and the work-piece is clamped inside a large aluminum casting mounted on the work-table. Abrasive is circulated from a reservoir through the hose to the nozzle, which directs the flow of abrasive on to the surface of the work. The aluminum casting collects the abrasive and recirculates it to the reservoir.

The transducer converts electrical energy into mechanical energy so that the cutting tool at the end of the cone is made to vibrate up and down at a rate of 27 kc per sec. With abrasive flowing, the work is brought up to the tool by elevating the knee. A force of from ¼ to 8 lb is maintained between the tool and the work-piece. This force feeds the tool into the work as the work surface immediately below the tool is disintegrated. The work-piece may also be fed sideways to cut slots of any shape.

What's a Transducer?

A transducer is a device for converting electrical energy into mechanical energy. A section through the transducer is shown in Fig. 2, and the transducer with cover removed is shown in Fig. 4.

Electrical energy is fed into the coil round the nickel laminations. This electrical energy causes the nickel laminations to vibrate rapidly. This vibration is amplified by the tapered cones so that the tips of the cones vibrate with greater amplitude than the laminations. The cutting tool is fixed to the vibrating end of the second, detachable, tool cone.

In converting electrical energy into mechanical movement the transducer uses one of the fundamental

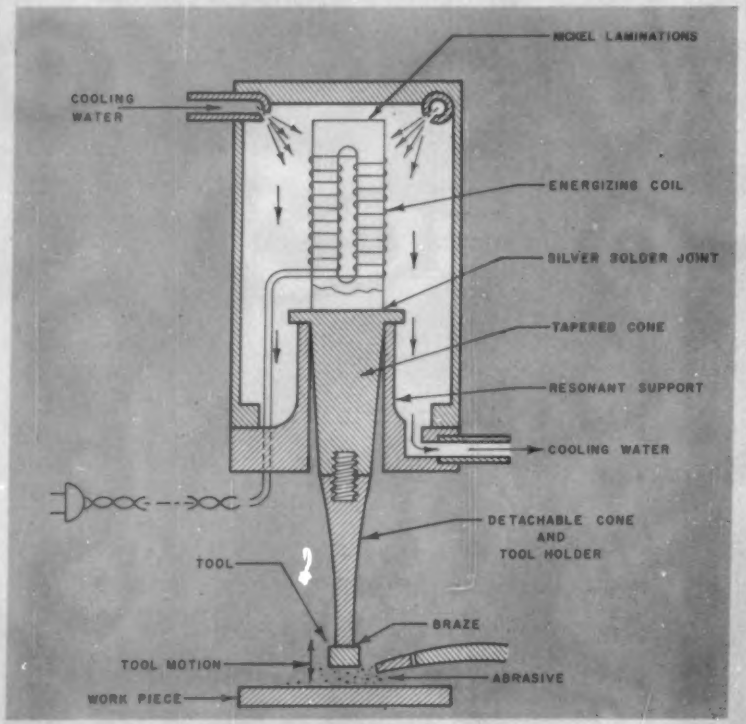


Fig. 2. Section through transducer, a device for converting electrical into mechanical energy. Vibrations of nickel laminations are amplified by conical tool holder

properties of nickel and several other metals and alloys, namely, that when a magnetic flux is set up in a rod of the metal, the rod actually changes its physical length. The mechanism of this energy conversion is called magnetostriction.

These vibrations are very small, and they need to be amplified. This is done in two ways. The nickel stack is designed to resonate at the frequency of the applied electric current, thus increasing the vibration amplitude many times, and then these large vibrations are further amplified by the cones acting as mechanical transformers.

Resonance

First, let us consider how the vibrations are enlarged in the nickel stack.

If the nickel stack is isolated in space and a current suddenly passed through its coil, an elastic shock wave will be propagated toward each end of the stack. At the ends of the stack, reflection will occur and the elastic wave will continue bouncing back and forth. If the current in the coil is turned off and on or varied at just the right frequency to augment and reinforce the reflected elastic wave, the wave will continue to increase in amplitude until limited by dissipation in the system. This is the condition of resonance.

As a result of this phenomenon, the change in the length of the stack may be increased many fold.

Transmitting Motion to Bit

After this ultrasonic mechanical motion has been generated by the nickel stack, some means must be used to couple the ultrasonic energy efficiently to the work-piece, and to hold the assembly secure without damping the vibrations. Figure 3 illustrates how this is done.

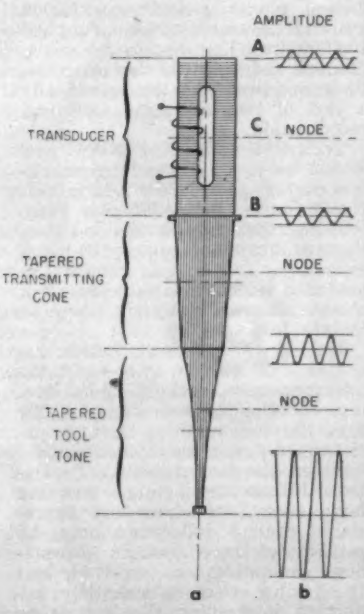


Fig. 3. Diagram shows how motion of nickel stack (ACB) is amplified at tool tip

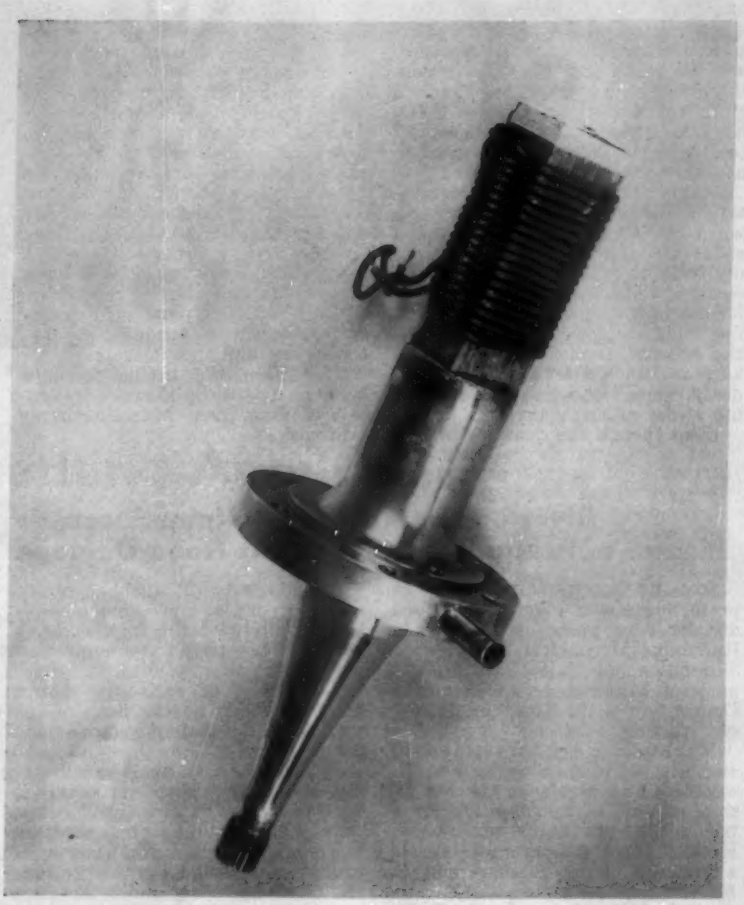


Fig. 4. Above. Transducer with cover removed. Coil encloses nickel laminations, whose vibration is amplified by cone. Cutting tool is mounted at tip of cone

If first the stack alone is considered (Fig. 3a), vibrating at its natural resonant frequency, with no external force, the center of gravity, C, does not move, but the two ends do. The relative motion of different parts of the stack is shown in Fig. 3b. Thus, when the longitudinal displacement is a maximum, end A has a maximum displacement upwards, and end B a maximum displacement downwards, while the center of gravity, C, has not moved.

Full-Wave Cone

It will be seen that the length of stack is virtually a "half-wavelength" in terms of amplitude of vibration, and by attaching a full-wavelength rod to the stack, the ultrasonic energy is made available at the cutting tool.

One way of showing that the amplitude of vibration must increase with decreasing cone cross-sectional area is by considering the basic principle of conservation of energy. If we assume that an elastic shock wave having a certain amount of energy, enters the top part of the cone and propagates in the direction of the small end, then, assuming no losses, the total energy remains the same as the wave travels down the cone. The frequency does not change, but the radius of the cone does, and as the radius becomes smaller the displacement must increase.

Theories of Material Removal

The principle described in the third paragraph of this article is only one of several theories put forward to explain the method of material removal by ultrasonic machining. There are many forces in operation at the tool-work interface. For example, if we consider the peak vibration obtained, which is around 0.004 in., we find that at this frequency the acceleration is 150,000 times gravity. This means that a tool about the size of a penny and weighing only 10 oz exerts a force of ½ ton on the end of the cone. Similarly, the accelerations imparted to the abrasive particles very probably have a considerable effect on removing material. These particles strike the work-piece with impact

forces up to 150,000 times their weight, thereby chipping or grinding an exact counterpart of the tool face into the work. It is from this action that the term "ultrasonic impact grinding" is derived. Despite these large instantaneous forces between tool and work, the steady force seldom exceeds 8 lbs.

Another possibility is that of cavitation, the phenomenon that results when accelerations within the liquid are greater than those which the liquid pressure can follow. Under these conditions, low-pressure cavities are formed in the liquid, resulting in the liberation of vapor. When these cavities collapse, tremendous forces, yet unmeasured, are released very suddenly. These forces may also contribute to the cutting action.

Even though the quantity of material removed by the ultrasonic machine tool is relatively small, the efficiency of removal is as good as or better than by conventional machining methods. That is, the power required per unit volume per time for material removal is comparable to that required in other methods.

The techniques and equipment for ultrasonic impact grinding have now been firmly established in a variety of industries with the result that they are virtually indispensable to the economic manufacture of many items such as carbide dies of all types, ceramic and glass parts for industry and for decorative purposes, jewelry, transistors, and many others.

The information in this article is based on a paper by Maurice S. Hartley, of Raytheon Manufacturing Company.

River on the Rampage—Union Electric's Precautions to Prevent Flood Damage

SOME INTERESTING REMARKS about protecting power plants from flood disaster were made by Edward A. Rudulph, Mechanical Engineering Superintendent, Union Electric Company of Missouri, at the June '55 Convention of the American Society of Civil Engineers.

Mr. Rudulph certainly spoke with authority. Union Electric has six steam-electric plants on the Mississippi around St. Louis, a hydroelectric plant on the Mississippi at Keokuk, Iowa, and one on the Osage, a tributary of the Missouri, and, as Mr. Rudulph observed, "this company is exposed to about all the combinations of hazards a river on the rampage can offer."

He pointed out that the tradition, built up by the pioneer operators in the electric power industry, of holding the load at all costs, had become so ingrained in the utility organizations, that the public by now had come to take for granted the reliability of power service. One result of this reliance has been that more and more important and expensive operations have become dependent on uninterrupted electric power supply, and the responsibility of a power supply has increased from one of financial responsibility to its owners to one of life and death responsibility to the community.

Some precautions taken to meet this responsiblity are best described in the following quotations from Mr. Rudulph's speech.

"At their worst, floods may spell disaster to a power plant or system of plants. But with proper planning and vigilance, they may be made to spell out only a few sleepless nights and a minimum of physical effort at the last moment. Limitation of disaster in the face of flood danger has required:

"1. Diversification of supply. Not too much of the system's generating capacity is in one power plant.

"2. Diversity in fuel supply — rail, river, or pipe line — plus accessible fuel storage during high water.

"3. Widespread interconnection with other power systems.

"4. Design of each new power plant extension on the basis of the most up to date information on flood probabilities.

"Even when all these conditions have been satisfied, power supply is not always maintained without a fight. I believe that all organizations operating power plants have what almost amounts to an instinct to keep the plant operating under the most extreme conditions of flood and the plant is not abandoned until the flood waters actually have invaded it. Even then, to whatever degree possible, measures are taken to insure that after the passage of the flood the plant can be returned to operation at the earliest possible moment. In the meantime, interconnection with plants in other areas not affected by the same flood assists in relieving the effects which might otherwise be disastrous to the community."

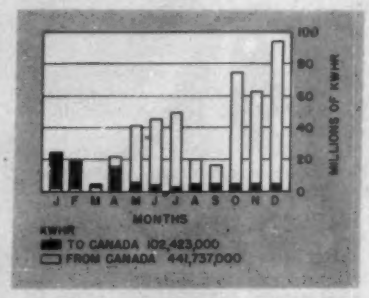
Citing Union Electric's battles with floods and the resultant protective measures, Mr. Rudulph said:

"We believe we now have a program by which we could meet most flood conditions at all the plants and that these plants could stay in operation for progressively higher stages, the older plants perhaps being taken out of service first, but at no time would we face a complete failure of service, even under the condition of the so-called project flood upon which now most of the protective systems are based and for which stages more than ten feet above the 1944 maximum are predicted. It is most important, however, that this program be reviewed year to year and that it be the responsibility of some member of the organization to have a plan in mind to meet unprecedented floods."

Detroit Edison-Ontario Hydro Interconnection

WHEN THE DETROIT EDISON CO. decided to build interconnections with the Ontario power system, the two prime factors considered were 1) greater emergency service, and 2) a savings in the cost of power. Results were reported in *Synchroscope*, the company magazine, 16 months later. All expectations were exceeded.

System interruptions had occurred on both sides of the river but without any serious consequences because of the power available from the mutual exchange during off-peak periods. Following the accident at the Hearn Station in Toronto, Detroit Edison supplied power to the Ontario system to help them over the high load period. Later, on December 5, 1954 when Detroit Edison was receiving some 65,000 kw from Ontario, circuits opened east of London, and the entire load of Southwestern Ontario, about 250,000 kw, came over the Detroit system without warning — a total load increase of 315,000 kw.



Transfer of power between two countries

Edison plants picked up 215,000 kw and Consumers Power supplied 100,000 kw. The system frequency dropped only slightly for less than three minutes. This was specifically a test of real operating skill and coordination.

Today, Ontario has seven new 75,000 kw hydraulic turbine generators operating in the Sir Adam Beck No. 2 Station below Niagara Falls. Water at that site is available to run them at maximum capacity 24 hours each day. The Detroit Edison Co. has used a considerable amount of this surplus power at night when the Ontario load falls off.

During 1954 Detroit Edison received 442 million kwh over the interconnection, making a total savings in coal of approximately 185,000 tons. (Savings resulting from the exchange of power are divided equally between the two systems.) To Detroit Edison the amount was not large enough to show any appreciable change dollarwise; only 3.5 per cent of the company's kilowatt-hour generation was involved. But the savings were substantially important in helping the system to maintain lower operating costs.

Fig. 1. Professor Harold Skamser, Director of the JETS program

Fig. 2. Robert Nelson, Olivet Club, with electro-timer he built

JETS Does Something About the Engineer Shortage

We need more engineers and we need them badly. JETS (Junior Engineer Training for Schools) lets boys know about engineering at a time when they are making up their minds which career to choose

FOR SOME TIME now we've been hearing about the national shortage of engineers — how Russia every year graduates more than twice as many engineers and scientists as we do — how their theoretical and mathematical training is ahead of ours — and how vital it is that something be done about it.

Now if you want more engineers to come out of universities you have to put more engineering students in. There are plenty of students entering but not enough are studying engineering. So the problem is not to produce more students, but to persuade those entering that they should take up engineering rather than some other profession.

Profession Explained

Most boys have to make up their minds about a choice of profession around the time they leave high school, and this is the best time to tell them about engineering — to tell them they are needed, and why, and to let them know what they will be getting into if they take up engineering so they will know if it attracts them and if it is the kind of work they will be able to do.

At Michigan State University this is being done in a particularly effective manner by an organization called JETS, which stands for Junior Engineering Training for Schools. Former Dean Miller and Harold Skamser, Professor of Engineering at Michigan State, played a large part in starting this organization, which operates by forming and supervising clubs in which high school boys get together under supervision to learn what engineering is and what opportunities it offers for their future.

To help new clubs get started, and to serve all clubs with information and an exchange of ideas, JETS headquarters at Michigan State has built a helpful store of material about engineering. New clubs receive kits listing interesting engineering projects, and a cross-indexed listing of more than 100 motion pictures about all phases of engineering available from industry without charge. A club newsletter, "Jets-O-Gram," is circulated to all clubs.

The club was organized in 1950 and has spread to include 50 clubs in four states, with a membership of over 1000 boys and girls.

Club members hear talks from experienced engineers in various fields so they can get a realistic idea of what engineering is like, they take trips to factories and construction jobs, try out fields of engineering by means of projects they carry out themselves, have a day in the field with a practicing engineer, present engineering and science programs in school assemblies, do various engineering jobs as a service to the school, attend an annual Engineering Exposition at Michigan State University, and enter projects and compete for prizes and scholarships. The scholarship program, offered to the outstanding student in each club, covers four years' tuition at Michigan State University.

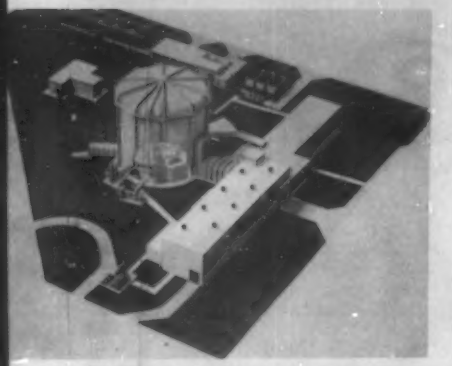
Students are encouraged to think up new ideas and projects of their own. The following projects give an idea of the kind of work done by these clubs, in mechanical engineering, constructing a jet-propelled model racer, constructing a cut-away model of refrigeration equipment; in electrical engineering, making a tin can motor, analyzing the use of electrical energy in each student's home, surveying electric power generation and transmission in the community; in civil engineering, making a traffic study of the student's locality, measuring the quantity of flow in a river and keeping a record of seasonal flow, estimating the weight of a building; in chemical and metallurgical engineering, making basic laboratory tests of fuels and lubricants, spark test for identifying metals; in agricultural engineering, job simplification, mechanizing a push type lawnmower, studying tractor loading and safety (using a model tractor); in engineering drawing, collecting and studying maps of the vicinity, and making drawings for a one-story house. These are just a few of the suggested projects. A complete list, for which detailed instructions are available, is furnished on request.

Program Reduces Drop-Outs

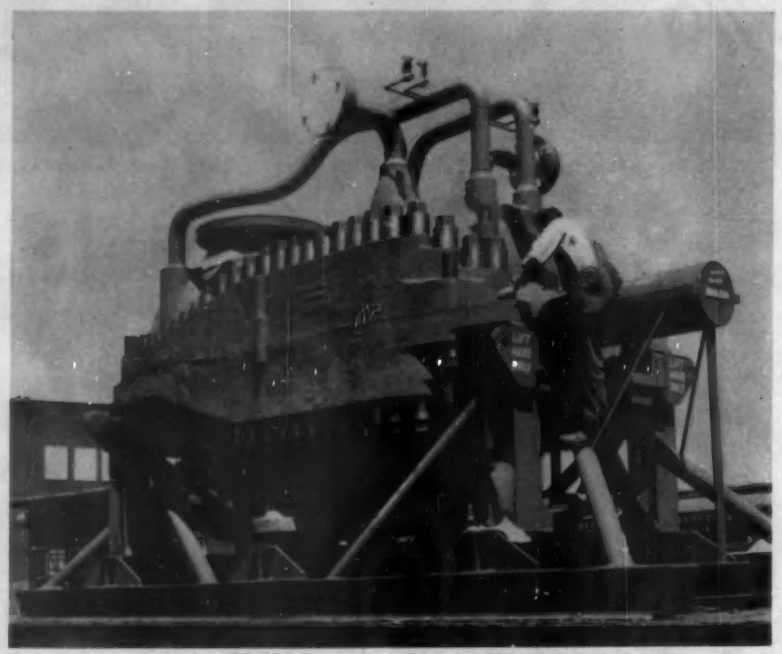
JETS club officials point out that the program is proving effective not only in stimulating interest about engineering but also in steering away from engineering students who have misconceptions about engineering or whose talents lie in other directions. They believe that in this way the program reduces the number of engineering "drop-outs," as students who quit school or change their courses of study in mid-stream are called. "Drop-outs" are an economic waste both to the students themselves and to the schools. Many educators believe that "drop-outs" are often caused by students who fail to realize until too late that mathematics and related subjects are musts for engineering. Thus the importance of mathematics and other "non-glamorous" aspects of engineering are emphasized by JETS clubs in giving students an accurate picture of what the college engineering student must know and do.

Detailed information about the program may be obtained by writing to JETS, Post Office Box 470, East Lansing, Michigan.

News Reel



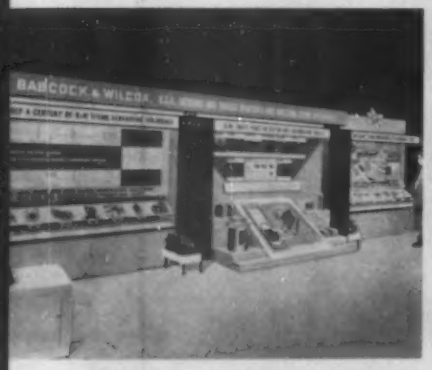
Model of Britain's "Dido" heavy water reactor shown at Geneva. Unit will be used to determine future reactor design



High-pressure end of a 75,000-kw turbine built by Westinghouse for Japan is shown ready for loading aboard ship. Unit is shipped from Sunnyvale plant

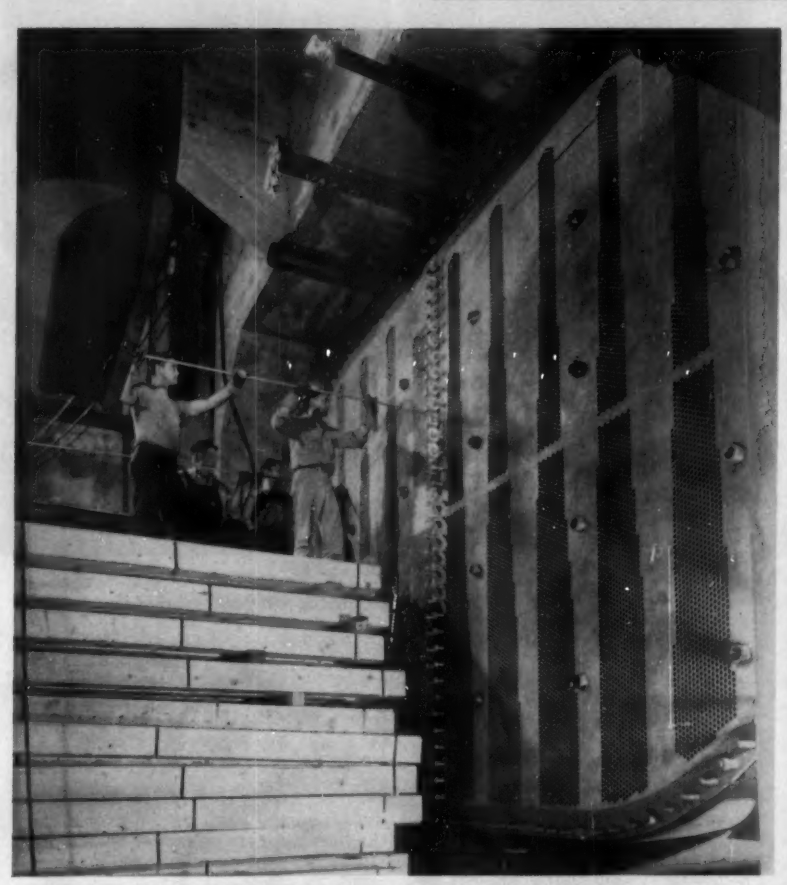
Model of ALCO's package atomic power plant is explained to Russian scientists by U. S. delegate (center)

Texas Power and Light has a king-sized mobile transformer — 106,000 pounds and 20,000 kva of it. It is cooled by forced circulation of 3400 gallons of oil and forced air. Ordered from Westinghouse for planned maintenance and emergencies

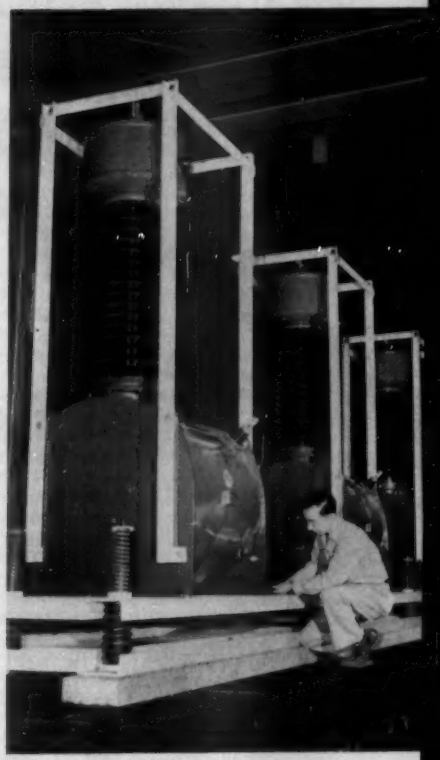


B & W Co.'s Geneva exhibit shows steam experience that led to Con. Ed.'s new fossil-atomic fueled Peekskill station

Crane Packing Co. starts research-office building on 17 acres, Chicago



Aluminum tubes go into this 105,000-sq-ft condenser that Allis-Chalmers is making for Wisconsin Electric's Oak Creek plant. Tests by both companies led to new unit



A-C now cradles its potential transformers on springs and cages the bushings in angle iron and wire for shipping safety

Kentucky's new Green River locks will improve navigation, and thereby commerce, in northwestern Kentucky when completed. That date is being moved up by integrated steel forms and scaffolding. Locks will be 84 by 600 ft at Calhoun, Ky.

Brackenridge, Pa., went from purchased power to its own diesel plant after 50 years with three 960-hp F-M o-p units

Pneumatic Wood Handling Cuts Fuel Costs by 60%

Where wood is being worked, it is common practice to use pneumatic collection systems to keep the dust away from machines and out of the air. Such systems work fine, but you must know their pitfalls to avoid heat waste, fire hazards and atmospheric contamination

By C. D. STRATTON*

IF YOU ARE working in wood products, how many cubic feet of heated air are you exhausting out of your plant per minute? Unless you have given special attention to the problem, the air picked up by the pneumatic dust collection system in your plant represents so much lost heat during the heating season. Also, your plant has probably been operating under partial vacuum and your heating boiler has been carrying unnecessarily heavy loads.

Operating a plant under partial vacuum results in violently slamming doors, high in-leakage of unheated air around doors, windows and building cracks — and can even result in the frequent re-puttying of window panes. Besides the extra cost of heating this leakage, it must be heated by uncontrolled mixing with warmer air in the building; hence, drafts.

In this sort of plant, the dust is usually picked up with large volumes of air at the machines and run to an outdoor cyclone for a nominal separating job. The air effluent from such a separator is seldom clean enough to return to the working space, so it is blasted out to atmosphere to create a neighborhood dust nuisance and — possibly — fire hazards. Above all, the heat in that air is lost.

We had all these problems, and then some, before we decided on a plant modification to correct them.

The over-all plan called for the reduction of dust in the air leaving the separators so that it could be returned to the plant. Better separation provided us with an extra fuel supply for our boilers (hence less coal to buy), and the reduced air makeup to the plant reduced the heating steam requirements.

First of all, to accomplish this, we revamped our blower system and installed bag-type dust collectors. The plant air temperature during the winter drops about 10 deg F in passing through these outdoor collectors, then the air is returned to the plant. The returned air, plus some makeup air through a blast coil, is equal the air removed by the pneumatic collection system so there is no vacuum on the plant. As a result of the heat saving and reduction of drafts, we were able to remove many of our radiators and a tempering coil.

Before the modification program, all of our wood cuttings were picked up by a local wood dealer and carted away. By adding a wood pulverizer, we were able to reduce this scrap to about the consistency of our dust and shavings and add it to the second pneumatic system that conveyed the plant dust to the boiler room. This arrangement is shown in Fig. 3.

Fig. 1. Sawdust and shavings are picked up at each machine with air

As a result of the greater efficiency of dust collection and reduction of heat losses, we reduced our fuel bill from $47,073 (1948) to $18,985 (1954). It was a gradual process, and we do not consider it to be complete yet (see Fig. 4).

Four 23,000-cfm blowers collect dust from the plant and deliver it to the four bag-type collectors outdoors. Here the dust accumulates in bins

*Superintendent of Maintenance, Grand Rapids Store Equipment Co., Grand Rapids, Michigan.

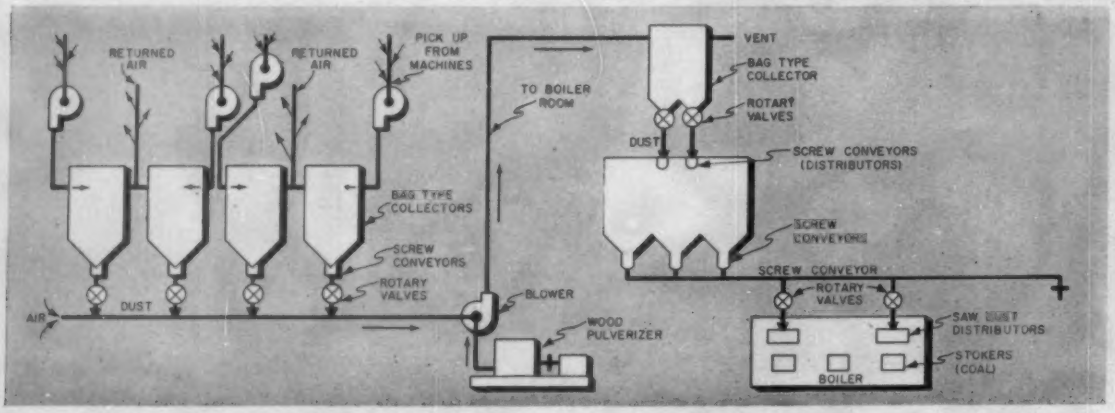


Fig. 3. Sawdust collection and conveying system with wood pulverizer integrated. Air from primary collectors returns to plant. Separate stokers fire dust, coal

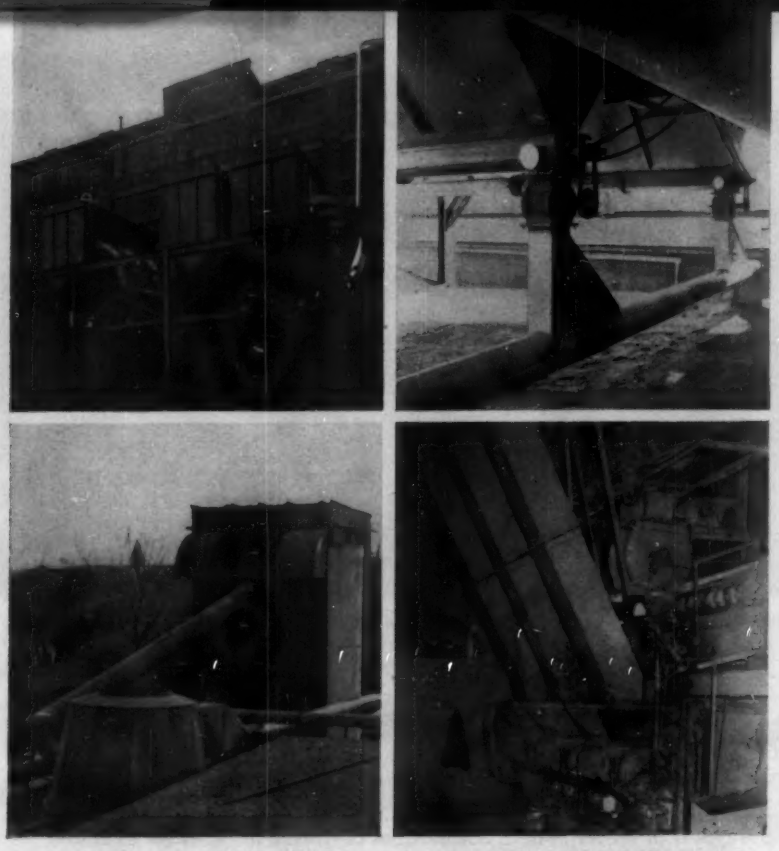


Fig. 2. Bag-type collectors (left) are shaken down only twice daily. Rotary valves (right) seal off unwanted air and fire at bins and sawdust stokers (lower right)

which are evacuated by screw conveyors into the second pneumatic system. We find it necessary to shake the bags down only twice a day. A fifth 23,000-cfm blower takes the dust plus the wood pulverizer product several hundred feet to the boiler room. The use of rotary valves to feed this dust into the second pneumatic system keeps the volume of air under control — otherwise a larger blower might be required.

On the roof of the boiler room, a fifth bag-type collector takes this dust from the air (which exhausts to atmosphere) and dumps it into two rotary valves which feed two unique dust distributors in a large fuel storage bin in the boiler room.

Formerly, the wood fuel was dropped into standard screw conveyors with square ports in the bottom to get distribution in the storage bin. This resulted in severe haystacking, plugging and reduction of storage capacity of the bin. Our modification of this distributor called only for closing off the ports in the bottom of the screw conveyor trough and cutting in a sloping slot from end to end. The high end is "upstream" and, as the slot slopes downward in traversing the trough, the dust spills out of the trough evenly into the bin.

Three screw conveyors in the bottom of the storage bin gather the dust and feed it into a common screw conveyor for delivery to the boiler. This common conveyor discharges into two sawdust distributors (similar to spreader stokers) through rotary valves. These valves serve two major purposes; they prevent flash-back fires from the furnace into the conveyor and storage, and they prevent the introduction of excess air through the distributors.

Sawdust is fired at a fairly constant rate in normal operation, with the load variations being taken up by three spreader stokers immediately below the distributors (lower right, Fig. 2). These stokers fire Pocohontas screenings, obtained locally for a little over $7.00 per ton. Most of the fuel, both dust and coal, is burned above the stationary grates in suspension. Only about 1–1½ inches of fuel lies on the grate.

It should be pointed out that economies mentioned earlier in this article, and shown by the monthly fuel charts, were accomplished through a three-fold attack. First was the reduction of heating requirements, then the salvage of more of the available waste fuel, and then the reduction of boiler heat losses (through controlled excess air). No single factor was spectacular, but the combination proved a winner when the fuel bills were totalled. Though somewhat more difficult to tabulate and allocate to this program, the reduced maintenance charges were significant.

In many cases, such systems have been operating for years — like ours — and are judged only by their own standard of operation. If they were compared with other and better engineered systems, they would be replaced in short order.

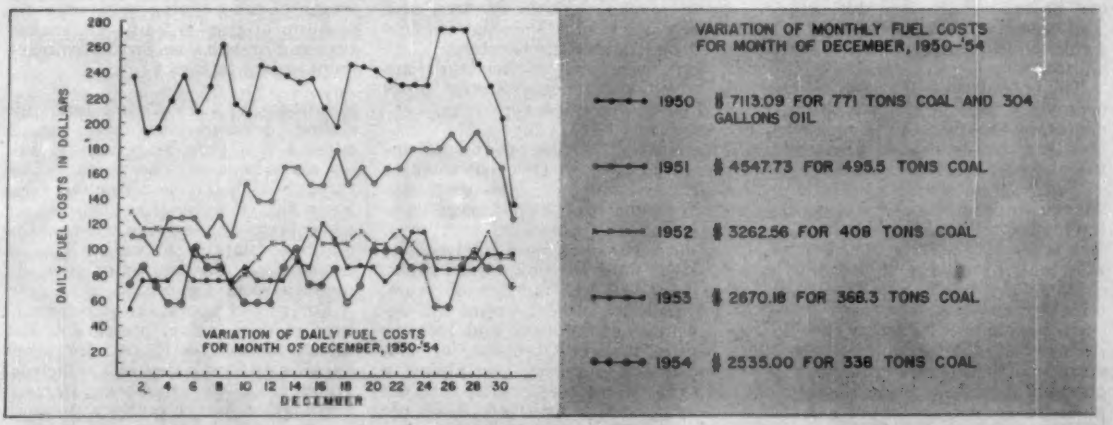


Fig. 4. Total cost of purchased fuel for month of December, 1950–54, show continuing reduction. Reduced heating load and increased use of waste made savings

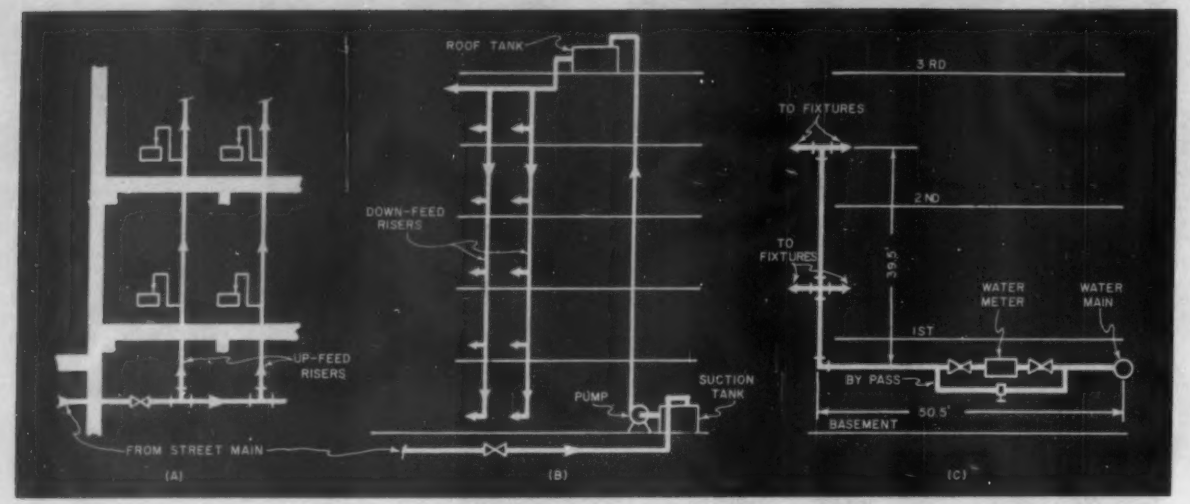


Fig. 1. Types of cold water system discussed here. A. Up-feed system. B. Down-feed. C. Up-feed system used in text example

Figure Pipe Sizes the Simple Way

With charts and tables given here you can figure pipe sizes and capacities for your building cold water system. Article explains principles of water system calculations and includes worked example

SOONER OR LATER, nearly every power engineer runs up against the problem of water supply. Either a new building needs a supply or an existing system has to be altered or submitted plans have to be checked.

For any of these reasons, engineers should be familiar with water system calculations. Further on in this article we present a typical problem which will explain the principles of these calculations. Before coming to this problem, here is a description of the most common system types.

System types: Either an upfeed or a downfeed system as shown in Fig. 1 can be used for cold water supply. The type of system used depends, as a rule, on the height of the structure, and the street main pressure.

The upfeed type of system is most commonly used in low structures of one or two stories. Street mains can then supply the needed pressure to the highest fixture in the building.

Where street main pressure is not enough to produce desired flow from the highest fixture, the downfeed system is used. Water is raised to the roof tank by means of a pump located in the basement. Upfeed systems require less pipe and fittings than downfeeds. Therefore they can be installed at a lower cost, but this should not be the sole criterion when choosing a system. Dependability of performance is more important than initial economy, especially when process units are served by the system.

Demand load: The amount of water which must be supplied to any system depends on the number and type of fixtures installed and how they are used. Table 1 and Fig. 2 show how to estimate water quantities.

The demand load or required flow for a group of fixtures used intermittently is determined by finding the product of the number of each type of fixture and the "weight" from Table 1, and then entering in Fig. 2 the sum of these products to find the necessary water flow.

Fixtures considered above are of the intermittently operated type, such as faucets and flush valves. Demand loads for other fixtures, and those which require a continuous flow must be calculated separately.

Some examples of this type are hose outlets, process supply pipes and air-conditioning apparatus.

Pipe sizes: Brass, copper and galvanized iron piping are generally used for cold water supply. Pressure losses for brass and copper pipe are given in Fig. 2. With galvanized iron pipe, pressure losses when new will be about equal to those for brass and copper. However, after a number of years, corrosion and other factors will reduce internal diameter and increase pressure losses. To allow for this condition when sizing iron piping, a flow rate 35 per cent greater than actually needed is assumed. A 50 per cent increase is used for waters containing lime and minimum branch line size used is ¾ in.

Besides the pressure loss in straight piping there is also a loss in ells, valves and tees. Table 2 gives the equivalent length of straight pipe for various fittings.

Typical example: The following example will show how this data is applied. It will also help to explain the various pressure relations which must exist in cold water piping systems.

An industrial plant located in a city where the minimum street pressure is 60 psi has its first fixture 39.5 ft above the main. Total number of fixture units installed is 75; water closets are flush-valve operated; length of brass piping between main and top of riser is 90 ft. Determine riser and branch sizes for the arrangement shown in Fig. 1 (c).

Solution: With 75 fixture units installed, demand load from Fig. 2 curve A is 16 gpm. Since a water meter must be used, the pressure loss through it should be computed first. From Fig. 3 it is seen that 1½ in. water meter is the smallest that will pass the required quantity of water. Also, a pressure loss of 9 psi occurs when the meter passes 60 gpm.

For proper operation of the usual type of flush valve, pressure at the fixture should be 15 psi; for other fixtures, an 8 psi pressure is sufficient. Difference in elevation between main and highest fixture causes a pressure loss equal to the product of distance in feet and 0.43. Assuming a 15 psi pressure at the highest fixture, pres-

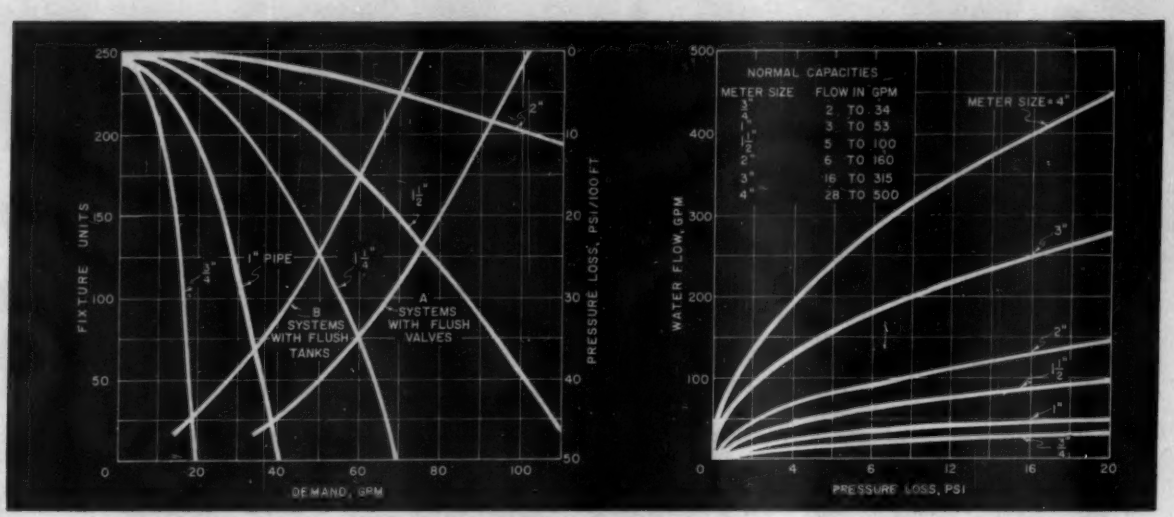


Fig. 2. Used to calculate demand load and pressure losses Fig. 3. Hydraulic characteristics of typical water meters

sure drop available for overcoming pipe friction is $60 - (15 + 39.5 \times 0.43 + 9) = 19$ psi. In other words, substact from street main pressure the sum of the pressure required at the highest fixture, pressure loss caused by difference in elevation, and water meter loss. The result is the pressure available for overcoming pipe friction. Once available pressure drop is computed, the pipe size can be found if the total length of pipe including fittings is known. However, in our problem, since only the length of straight pipe is known, the equivalent length of fittings must be assumed. After the pipe size has been selected, actual equivalent length of fittings can be computed and compared with the assumed figures. Any necessary corrections can be made at that time.

Thus, assuming an equivalent length of 35 ft, the total equivalent length of piping equals $90 + 35 = 125$ ft. To express pressure loss in the usual terms of psi/100 ft, allowable loss = 19 (100/125) = 15.25 psi/100 ft., say 15. Referring to Fig. 2, a 1½ in. diam pipe is satisfactory. Assumed equivalent length of fittings is now checked against the actual length to see if the two agree. Should the actual length be greater than assumed, pipe size must be altered accordingly.

Branch size calculations are summarized in Table 3. Study of this table shows that there is little difference between riser and branch calculations. Although the system described here is of the up-feed type, down-feed systems are designed in a similar manner. The elevated tank supplies pressure instead of the main.

Other fixtures: Hose bibb, process fixture, and air-conditioning water quantities were neglected in the above exmple. But if they were used, the quantities needed would be added to the demand load before determining pipe size.

Table I. Industrial fixture demand weights, used in conjunction with Fig. 2

Type of Fixture	Demand Weight
Water closet—flush valve	10
Water closet—flush tank	5
Wall or stall urinal—flush valve	5
Wall or stall urinal—flush tank	3
Lavatory—faucet	2
Shower—mixing valve	4
Service sink—faucet	3

Note: Where both hot and cold water are supplied to a fixture, demand weight can be taken as 75% of the listed figure.

Table II. Equivalent length, in feet of straight pipe, of fittings, valves

Pipe size, in.	90° elbow	45° elbow	Tee	Gate valve	Globe valve
½	2	1	1	1	17
¾	2	1	2	1	21
1	3	1	2	1	29
1¼	4	2	3	1	38
1½	5	2	3	1	45
2	5	3	3	1	58
2½	7	3	5	2	68
3	8	4	6	2	82
4	11	5	7	2	115

Note: These figures are for screwed fittings only.

Table III. Fixture weights for use with various branch pipe calculations

No. and Type of Fixtures		Fixture Weight
2 WC flush valves	2(10) =	20
3 Shower mix. valves	3(4) (0.75) =	9
2 Lavatories	2(2) (0.75) =	3
Total Fixture Units	=	32
Demand (Fig. 2)	=	40 gpm
Pipe size (Fig. 2)	=	1½"

Your Boiler Can Enjoy Water

REMEMBER that interesting little article entitled Comic Characters Explain Water Treatment, which showed a method of teaching the fundamentals of boiler water conditioning by means of cartoon characters? It appeared in the January 1954 issue of POWER ENGINEERING, and scores of readers wrote us to get more information about the method.

It was worked out by Thomas H. Waldron and used in a course in fundamentals of operating engineering that he was conducting at that time at Wright Junior College in Chicago.

The idea started as a slide lecture delivered by Mr. Waldron as part of this course; it did not pretend to be an exhaustive study of the subject, but was designed primarily to stimulate interest in what is often considered a mysterious subject by boiler operators. The results have justified the method, for men with little knowledge of chemistry have been able to follow and remember the subject when it has been presented in this way.

Using cartoon characters to identify the impurities found in Great Lakes water, Mr. Waldron illustrates, in a rapid cartoon sequence, the manner in which each impurity causes damage under conditions found in a boiler and the methods that can be used to prevent this damage. He gives illustrations and directions for using the actual testing equipment and procedures for finding out what the impurities are.

Silica specializes in troweling a hard glassy scale on the boiler heating surfaces, and due to its low rate of heat transfer, a thin coating of silicate scale can account for more damage from overheating than a comparatively heavy layer of scale that is predominately carbonate. In order to combat silica effectively, we must understand the manner in which silica forms scale.

Portion of typical page from Your Boiler Can Enjoy Water booklet, showing the way silica is represented by a specific cartoon character and what the character does under various conditions. Each impurity represented by different character

In this booklet, the author explains the various impurities, identifying each by a different cartoon character. The scale forming impurities in Great Lakes water are calcium carbonate, magnesium carbonate, calcium sulphates, silica and compounds of iron and aluminum. Non-scale forming impurities are sulphates, chlorides and nitrates of sodium and potassium and suspended matter. The author explains in simple language what each of these impurities is, shows how to determine water hardness, then discusses the carbonate twins and how to control them, then shows what silica does. The accompanying illustration shows the way he uses cartoons to illustrate formation of silica scale in boiler water, to aid the explanation in text.

Booklet is definitely intended for boiler operators and does not presume to compete with the vast fund of available technical knowledge on water conditioning. But it does bring out basic knowledge that the operator should have in order to go into the subject in more technical detail.

The booklet, entitled Your Boiler Can Enjoy Water, is copyrighted and is available from the author, Thomas H. Waldron, The Waldron Film Illustration Co., 6025 West Henderson St., Chicago 34, Ill., for $1 per copy. Please DO NOT send us any money for we are not selling the book, but if you want it, get directly in touch with Mr. Waldron at the address given.

New Booklet Shows Proper Use of Hot Line Tools

AN EXCELLENT LITTLE BOOKLET, which should interest everyone concerned with hot line tools, was recently published by the Edison Electric Institute. It is entitled "Hot Line Tool Guide," and it is taken from a report by the Subcommittee on Hot Line Tools of the Accident Prevention Committee, Edison Electric Institute.

The report gives general information on some of the present-day hot line practices being used successfully. As stated in the foreword to the booklet, it is not intended as a complete operating manual or rigid guide on the subject, as individual practices and policies will vary among companies. But it gives a lot of useful general information and in particular it stresses the accident prevention phase of hot line work.

In addition to a large number of very good 3½ by 4½ action photographs showing various hot line tool applications, the booklet gives general instructions on selection and care of tools, hot line work, job planning and responsible supervision, training programs, and working clearances.

Copies of the booklet may be obtained from Edison Electric Institute, 420 Lexington Avenue, New York 17, N. Y., with the following discounts: 25 through 49 copies, 10 per cent; 50 through 99 copies, 15 per cent; 100 through 199 copies, 20 per cent; 200 through 299, 30 per cent. For orders over 300 copies special discounts will be arranged.

Algoma's New Automatic Boilers Turn Themselves On or Off

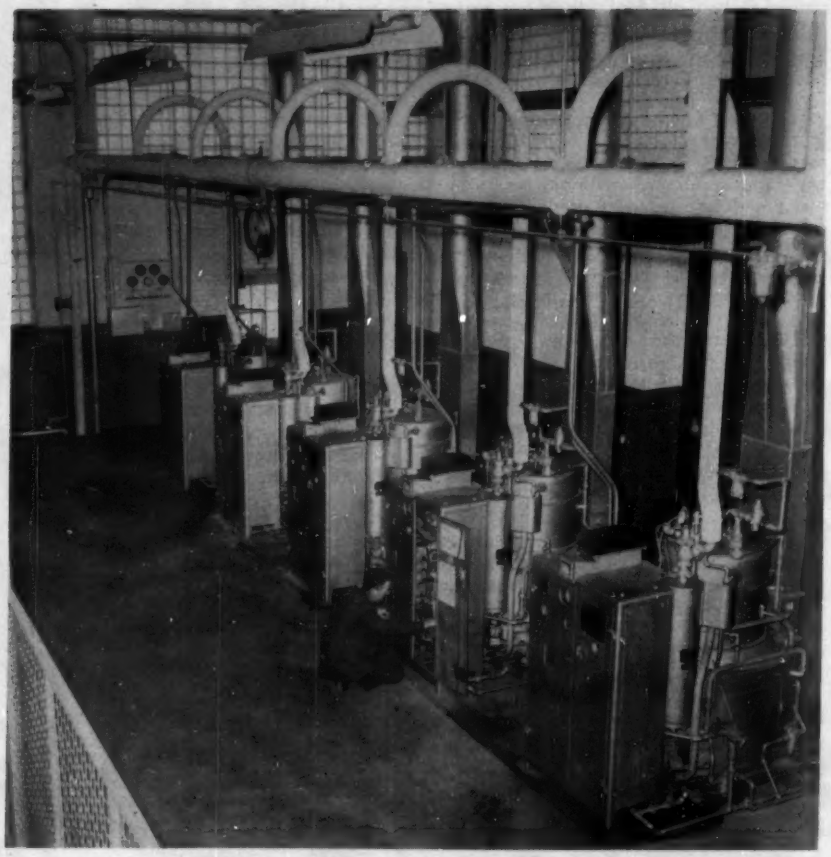


Fig. 1. Line of five automatic, oil-fired, packaged steam generators recently installed in main shops of Algoma Central Railroad at Sault Ste. Marie, Canada

IN A RECENT OVERHAUL and modernization of steam generating facilities in its main shops at Sault Ste. Marie, the Algoma Central Railroad installed five Vapor automatic, oil-fired, package type steam generators. The decision to replace the old coal-fired boilers with the package type units was influenced by the fact that the railroad has been using the same type of steam generators for over three years to heat diesel passenger trains. Shop men are familiar with the units, and parts are interchangeable between train and shop installations.

The new units are controlled automatically to meet shop steam requirements and have the capacity to produce between 800 and 15,000 pounds of steam per hour. During the summer, 800 pounds of steam per hour at 80-psi pressure is used to clean locomotive parts. In the winter, more steam at reduced pressure is needed to heat over 3,000,000 cu ft of shop and office space as well as stand-by passenger cars on the outside ready track.

A feature of the new steam plant is the master control which starts up additional steam generators as they are needed to meet demand. Conversely, the control cuts out units when demand drops.

The controls are actuated by steam pressure; when demand causes pressure to drop from the normal 80 psi to 70 psi, a low-pressure switch initiates the start-up cycle and an additional unit comes on the line automatically; in a matter of minutes, an added 3000 pounds of steam per hour are available to handle the increased load.

Fig. 2. The controls, servo, feed water pump, neatly enclosed in metal cabinets

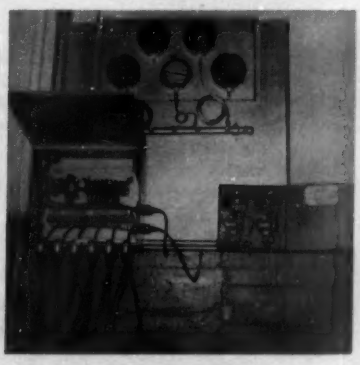


Fig. 3. Master steam generator control; right, automatic blowdown control unit

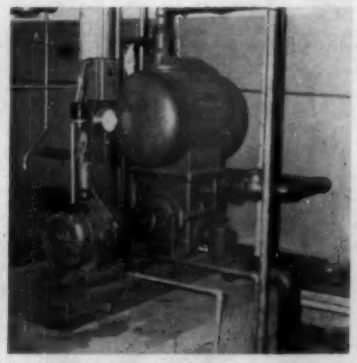


Fig. 4. Vacuum pump pulls 7-in. vacuum on heating system to return condensate

Performance Data for Sprayed-on Foaming Plastic Insulation

ELASTIC....

In March '55 we described a new type of sprayed-on insulation called Poly-Cell. Since then we have received hundreds of inquiries asking for more information. Here's a short description of this new insulation with the more common questions and answers about it

To apply this new insulating material you merely paint on or spray a thin coating of a viscous plastic material resembling heavy varnish on to the surface to be covered. In about 15 minutes the material swells up to 20 times the coating thickness and forms a foamy, semi-rigid insulation. The insulation thus formed has a K factor of 0.24, a density of slightly more than 2 lb per cu ft, will not support combustion, and adheres to surfaces without mechanical attachments. (See Paint-On Insulation Foams to Thick Coat, POWER ENGINEERING, March 1955, page 59.)

Here are some readers' questions and answers which give more information about this new type of insulation.

Q. What are the maximum and minimum temperatures at which this insulation can be used?
A. Maximum 220F. Minimum—40F. At 220F it starts to soften and gets progressively softer as the temperature rises. Though it still has good insulating value when soft it is not recommended that it be used above this temperature.

For the minimum temperature—40 is recommended because equipment has not been available for testing below this figure. Further testing may show it is good for lower temperatures than this.

Q. Will it stand vibration and shock? Specifically, will it pass tests according to General Specification for Environmental Testing of Aeronautical and Associated Equipment, MIL-E-5272A of 9.16.52?
A. Yes, to both questions.

Q. Is there a fire hazard while it is being applied?
A. No. No volatiles or inflammable solvents are used for its application.

Q. What is the natural color of the insulation, and can a pigment be added to give it a specific color?
A. Its natural color is ivory or creamy white. It can be made any color by adding a dye of the required tint before spraying.

Q. Can you apply it over cork that is in good condition?
A. Yes.

Q. Does it stay pliable or elastic so that under changing temperatures it does not crack?
A. Yes.

Q. Can you apply it with a regular paint gun?
A. No. At present it needs special equipment for its application, and this equipment is held by the manufacturer or its agents. However, development work is proceeding on equipment that could be purchased.

Q. Is it water resistant?
A. No. It will absorb water unless protected. If the normal protective skin it acquires during application is unbroken, it will absorb 40 per cent of its weight if immersed in water over a 25 day period, and if the skin is broken it will absorb 100 per cent.

Q. Is it useful as a sound insulator?
A. Yes. Coefficients of sound absorption are as follows, based on a 2 in. thickness of insulation. 0.79 for 250 cps
0.99 for 500 cps
0.97 for 1000 cps. Average density is 2.2 lb per cu ft.

VIBRATION....

Q. How much does it cost?
A. Each application will depend on many factors, such as quantity required, amount of scaffolding required, location on job, which part of the country it is required, etc. However, for an average application, including scaffolding and some surface preparation, for ½ in. thickness of insulation, an approximate over-all figure of 50 cents per sq ft may be taken.

Q. Is it suitable for insulating the bottom of a concrete slab roof?
A. Yes. It has good adhesion and is a good condensation control insulation.

Q. Will it resist 212F steam vapors?
A. No. It is not suitable for immersion in wet steam.

Q. We want to apply additional insulation to a ceiling underneath a room which has a temp of −10F. The floor of this room consists of 4 in. of cork on top of a concrete slab, then a 4 in. concrete wearing floor on top of the cork. We would have to apply the insulation to the ceiling of the basement which is directly under this floor. The basement is damp, and, of course, the floor is cold. Would this sprayed-on insulation be suitable for this application?
A. Yes.

Q. We want to winterize engine enclosures and operator cab enclosures at temperatures down to −65F. Would this insulation be suitable?
A. It would probably be OK, though, as mentioned in a previous answer, so far tests have been carried out down to −40F only.

Double-Density Concrete Is Strong, Acid-Resistant, Easily Mixed and Poured

CONCRETE that weighs 290–300 lb per cu ft (about twice the weight of normal concrete) can be made with standard Portland cement and an aggregate of ferrophosphorus. Its strength at 60 days is 4810 psi (compressive), and it will not dissolve in acid according to the manufacturer.

More dense than concrete made with low-grade iron ore aggregate, which has been done to increase concrete density in the past, the ferrophosphorus concrete will cost more. It will cost less, however, than concrete that has been weighted with steel shot, punchings or scrap. No sand or gravel is used in the mix. The recipe for one cubic yard is:

4070 lb coarse ferrophosphorus
2710 lb fine ferrophosphorus
730 lb Portland cement
46 gal water

This can be mixed in standard equipment without segregation of the aggregate, which was one trouble with steel filler materials. The result is a uniformly dense mass that can be poured and which sets the same as any other cement mix.

IF YOU would like a data sheet on ferrophosphorus aggregates, with some data on the concrete mixes, jot "Dense Concrete" on the prepaid postal card elsewhere in this issue, or write the Editor.

Developed for shielding atomic hot cells with only half the thickness of concrete, it should find numerous applications in less glamorous industrial installations. Inertial loading of vibrating machinery, especially where there is no room for large foundations, is an obvious possibility. Its acid resistance should find extensive uses in industrial plants, possibly as facings for conventional concrete.

Some applications have been made of this material as filler in paints and plastics. They become much more dense and can take on new jobs in the atomics field when so treated. Phenol formaldehyde plastics with a ferrophosphorus filler can be machined to close tolerances.

New Vepco Station to Burn Three Fuels

VIRGINIA Electric and Power Co. has retained Stone & Webster Engineering Corp. to design and construct a new dual-purpose power station of 165,000 kw capacity on the York river about six miles east of Yorktown, Va., to cost more than $20,000,000.

This is the first power plant designed specifically to use a new refinery by-product as fuel. This fuel, known as "delayed coke," will be supplied by the American Oil Co. which is building a large refinery on adjacent property.

The new station will contain a 1,200,000 lb-per-hr steam boiler which will operate under pressure of 2000 psi at superheater outlet and an initial temperature of 1000 F with reheat to 1000 F. The turbine generator, which will have a rated capacity of 150,000 kw, is the first preferred standard turbine to be designed by General Electric Co. in that large size. Virginia Electric & Power Co. thus carries on its policy of progressive engineering as they were also the first utility to purchase a 100,000-kw preferred standard turbine, known as Chesterfield Unit No. 3, and the second to install a controlled-circulation steam boiler. The only earlier boiler of this design in the United States, but of a different type, was also installed in the Somerset Station of the Montaup Electric Co. by Stone & Webster Engineering Corp. in 1941.

The three fuels to be used — delayed coke, coal and refinery gas — will be fired simultaneously. The power station will be set up to use 100 per cent coal and up to 85 per cent delayed coke, as circumstances warrant. Solid fuels will be pulverized.

The power station will be a functional semi-outdoor type. A steel structure with corrugated asbestos siding will house the turbine and the firing aisle, with the boiler outdoors. A service building containing offices, shops and warehouse will also be built of steel and asbestos. It will have a total floor area of 22,200 sq ft, of which 5000 sq ft will be for air-conditioned offices.

Design work on the project is under way and the completion of the station is scheduled for July, 1957.

Fig. 1. *(Left)* Night lighting of GM's "World's Fair of Power" sparkles on Chicago's lake front; electricity for lighting, all other purposes, furnished by rail cars (Fig. 2, *right*).

Mobile Power Units Power POWERAMA

Fig. 3. Powerama theme is celebration of 100 millionth GM-produced diesel hp

TO CELEBRATE production of its 100 millionth diesel horsepower, General Motors Corporation set up an elaborate exhibit of modern power potential on Chicago's lake front during September that drew crowds which must have exceeded even the publicity department's dreams.

Called the Powerama, the show occupied 1,000,000 sq ft on the 1933–34 site of the Century of Progress exposition and straddled South Lake Shore Drive. With all GM divisions participating, practically everything that moves by diesel power was represented — and the total was impressive. But even more impressive is the realization that this is the power contribution of only one company in a relatively few years. Add to this the total of all other American manufacturers of power generating equipment in the past 50 years and the sinews of American strength become

Fig. 4. Power center for exhibit; four mobile rail cars feed to main distribution station (in center foreground). All cars can be run together, synchronized

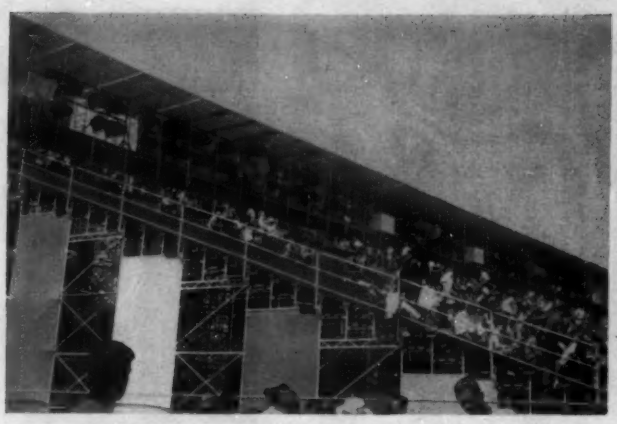


Fig. 5. One of the biggest fluctuating loads at exhibit is stage show lighting at top of 7000-seat grandstand. Served by six 100-kva transformers, big lights illuminate elaborate hour-long stage show featuring tractors, elephants, girls

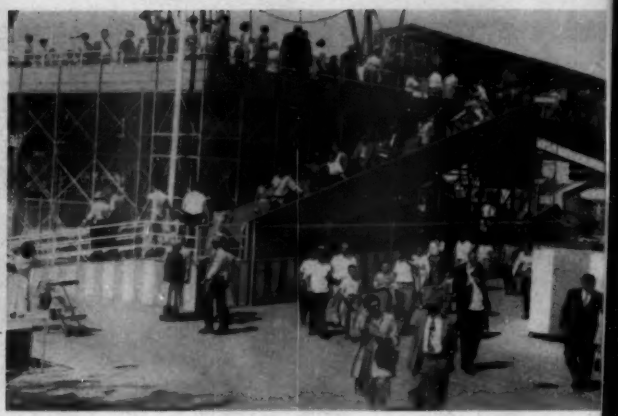


Fig. 6. Visitors to oil rig platform take it easy going up or down; 2 Stephens-Adamson Speedwalks, steepest ever built, give sightseers needed rest. Moving sidewalks handle 3600 persons per hour; power, 7½-hp motor (up), 3-hp (down)

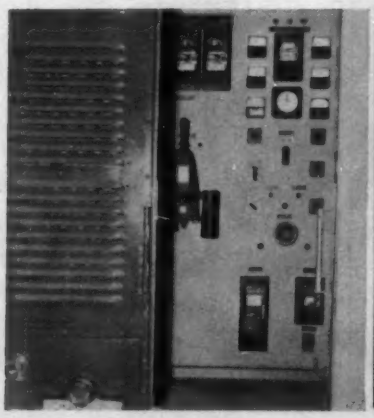
Fig. 7. *(Above)* Mobile highway unit has 500 kw capacity, is tied in with rail car supply to show. Fig. 8. *(Below, left)* Shows control panel at back of truck. Fig. 9. *(Center)* Operator with telephone. Fig. 10. *(Right)* This shows bus tie-in connection

unmistakably clear to all observers.

To us, one of the most interesting facets of the exhibit was the mobile power units that provided all the electricity utilized on the grounds. Four Electro-Motive rail cars were rolled in to supply power that would have been inconvenient to purchase from Chicago's Commonwealth Edison Corp. It would not have been a paying proposition for Edison to run lines under the Illinois Central tracks for a one-month show, so in came the mobile units. Rated at 1000 kw each, the cars are supplemented by a highway truck unit rated at 500 kw. Commonwealth Edison has purchased one of the rail cars and the highway unit. Delivery will be made after the show.

Rail cars are powered with 16-cylinder E-M diesels rated 1440 bhp at 720 rpm and have a capacity of 1250 kva. One unit is run as a frequency stabilizer, others follow.

The highway truck unit is equipped with an 8-cylinder E-M diesel used in their standard switch engine, and this engine develops 720 bhp at 720 rpm. Unit weighs about 69,000 lb.



The Gas Turbine Primer

Part I

Introduction

GAS TURBINES all operate on the same basic principle, though there are several ways of going about their job. They work on a gas to get it into the engine and increase its pressure, then heat the gas in one of several ways, and finally allow it to work its way out of the engine through one of several types of turbine wheels. Figures 1 and 2 caricature the most common cycle. For a number of generations, engineers were unable to get the gas to work as hard getting out of the turbine as they had to work getting it in and compressed. Naturally, each time the cranking engine was disengaged, the turbine would stop.

Many of the early-bird engineers got discouraged by this sort of thing and went into other lines of development. Still others decided to try a gas turbine cycle which required no compressor — an "explosion turbine". This unit (see Fig. 3), developed separately by several different engineers, would operate even after the cranking engine stopped, but the fuel bills made them wish it hadn't. The unit was not competitive with other prime movers of its day, which made it a pretty bad power plant indeed.

It became apparent very early that the gas turbine needed three things if it were to be practical. The first was a high-volume and high-compression-ratio compressor, because the cycle required tremendous quantities of high-pressure working air. The second was a general improvement of the efficiencies of the turbine, compressor, and air passages. The third need was a high-temperature material for combustion chamber and turbine wheel construction.

Ordering such things and getting them are two different things, even today. As time went by, the prime movers competing with the gas turbine became more efficient and reliable, so the small gains made on the gas turbine's requirements were wiped out from a competitive viewpoint. The situation became somewhat like the donkey with a carrot suspended just out of reach — and attached to the donkey.

It was not until the middle 1930's that separate programs being carried out in Germany and England began to show results. The principal line followed by the English (under Sir Frank Whittle) was the development of an engine using a high-capacity compressor of the centrifugal type. The Germans were working mostly on engines using the axial-flow type compressor. Both programs were aimed at the development of a lightweight aircraft jet engine for short-range, high-speed fighters.

Stationary gas turbines benefited

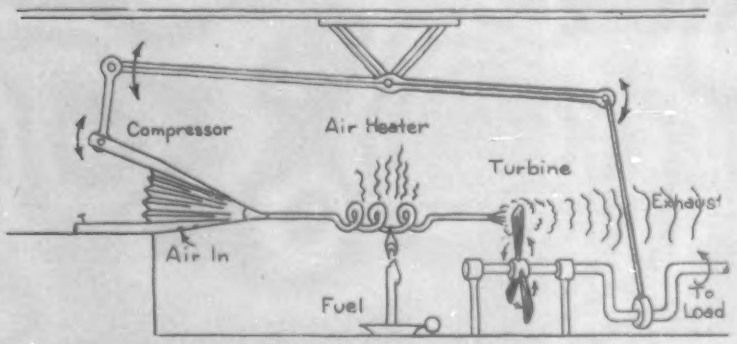


Fig. 1

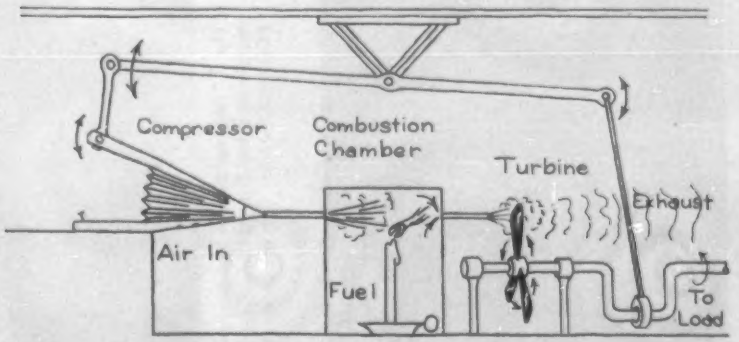


Fig. 2

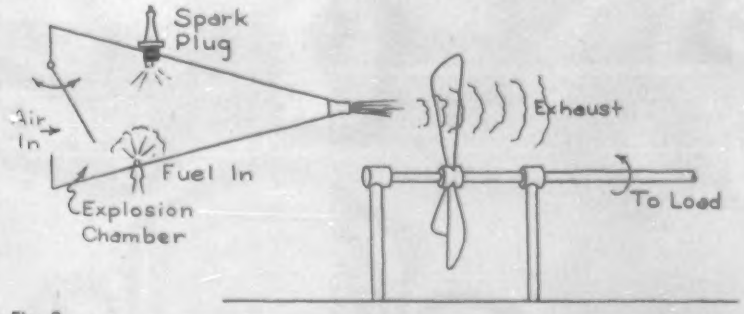


Fig. 3

fold along this line—outside edges toward you

In our cycle, what we really want is to compress air to one of the *pressures and temperatures* from which it can expand back to its original pressure and temperature, giving up as much work in expanding as was needed for compression (see Fig. 7). These important pressures and temperatures are just as characteristic of a given gas as the number of atoms in each of its molecules. A perfectly reversible cycle of compression and expansion is never actually attained because neither the compressor nor expander (turbine, for example) is perfect.

In our cycle, then, what is an inefficient compressor?

If we put a given quantity of work into a compressor that we know to be inefficient for our purposes, this shows up in several ways. To begin with, when we attain our desired pressure, we will have a higher temperature than the "ideal". If we assume a 100-percent-efficient turbine expander and then run this air through it, we will have a higher temperature when we reach the original pressure. The gas is then completely expanded and can do no more mechanical work (which is all we really want from our turbine) so the energy gain of the gas passing through the cycle is just so much wasted heat.

The situation is thermodynamically embarassing: Here we have an engine designed to convert heat energy into mechanical energy, and it back-slides by converting mechanical energy back into heat.

As we mentioned earlier, there are no compressors which will produce these perfectly reversible conditions, but the closer we come to it the higher will be our cycle efficiency. Compression which can always give up the work done on it by such perfect reversal is called *isentropic compression*. Just to confuse the issue, it is also called *reversible adiabatic* compression.

The higher the pressure out of the compressor compared with the pressure in, the greater will be the temperature gain through compression (see Fig. 8). The higher this compressor-induced air temperature before we start burning fuel in that air, the higher the simple cycle efficiency. Since the temperature is dependent on the ratio of pressure out to pressure into the compressor, we can state that the simple cycle efficiency goes up and down as the compression ratio goes up and down.

Intercooling—What and Why?

A practice often employed to reduce the work required to compress air is *intercooling*. This involves extracting air one or more times before it reaches full pressure and removing some of the heat caused by compression. Two or more stages of compression are necessarily involved (see Fig. 9) or we would be unable to do more than cool the completely compressed air, which would save no power.

But why throw heat away deliberately? Even if we do save work usually earmarked for compression, we only have to add this heat back to the cycle by burning more fuel — and the heat removed from the air is seldom if ever saved.

With the system or cycle as it stands now, just compression, heating and expansion, the cycle efficiency will not gain through intercooling. The turbine can produce more useful work, however, and still not exceed the maximum cycle temperature imposed by the turbine blades. *Cycle efficiency will not significantly change* because of the extra fuel we must burn.

There is a much better reason for intercooling than increased unit output. Intercooling requires a source of cooling water, and it would usually be simpler and possibly cheaper to just get a larger simple cycle turbine. *Intercooling sets up the best conditions for salvaging the heat wasted in the exhaust gases.* If we can intercool without losing efficiency, then the salvage of exhaust heat can only increase the efficiency. The process of salvaging the heat for reintroduction into the cycle is called *regeneration*.

Regeneration

Regeneration, added to the simple cycle gas turbine, means that the cycle is no longer simple; so it is called the *regenerative cycle* instead. When waste heat is recovered from the exhaust but put into some other cycle, the gas turbine cycle is still called simple — which shows what a name is worth.

Recovery of the waste heat from the exhaust requires an exchange of heat from the exhaust gas to the air as it comes out of the compressor (see Fig. 10). Remember that our compressed air is hot, its temperature depending on the amount it is compressed and the efficiency of the compressor. Also remember that

fold along this line—outside edges away from you

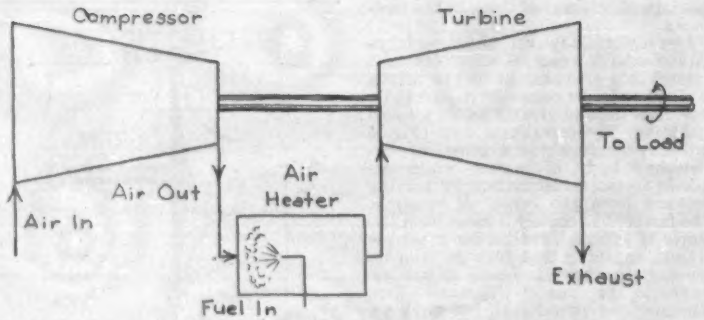


Fig. 4

greatly from this war-time activity. When all the smoke cleared away, engineers discovered that they had two excellent compressors, greatly improved turbine blade metals, improvements in the combustion chambers, better understanding of air flow problems, and a lot of favorable publicity that helped the financing of experiments a great deal.

This notoriety suddenly gained for the gas turbine worked something of a hardship on the engineers, however. Industry and the public were psychologically ready for the gas turbine, but the gas turbine still ran up a fabulous fuel bill — even burning kerosene. In the smaller automotive and odd-job sizes, the compressor efficiencies were much lower than those developed for aircraft. In the really large sizes — several thousand horsepower — their general gains in efficiency still had not caught up with the big steam plants which had higher efficiencies and burned cheaper fuel. The gas turbine still packed more power in a given space, however, and this advantage did a lot to keep things moving.

Gradual improvements in the smaller compressors and turbine blade materials followed. Centrifugal compressors attained efficiencies of about 75 per cent while the axial flow compressors reached 85 to 90 per cent. Turbines reached 80 to 85 per cent efficiency. Pressure ratios (outlet pressure divided by inlet pressure) increased during this period. These factors all combined to allow the engineer of today some choice in the type of cycle and the type of equipment he can employ. The very fact that he can now choose the best equipment for the job from an array of *good* equipment improves the outlook for gas turbines considerably.

Now that the engineer has some choice in the matter, what sort of cycles should he employ on different jobs? There is an amazing variety of cycles, and the engineer who may someday buy or operate such units has an obligation to know what goes into them.

Open Cycle Operation

Open cycles take in the air, compress it, heat it, and blow it through a turbine back to the atmosphere. The equipment is extremely light and relatively cheap. Figure 4 shows the traditional picture of the "simple cycle" unit, which is an open cycle unit with no frills whatsoever.

So many variables influence even the simple cycle turbine that generalizations are easily challenged. It is generally true, however, that for a given maximum temperature in the turbine, *an increase in the pressure ratio will increase the cycle efficiency and decrease the exhaust temperature*. This does not always hold true for the same turbine which merely operates at higher pressures than it was designed for; the *compressor* efficiency may drop enough through this off-design operation to offset the *cycle* efficiency gain.

At this point it is customary to trot out the mathematical equations and diagrams to explain the vagaries of air compression, heating and expansion. This "primer" presentation, however, will forego the luxury of convenient mathematics until the end — and then treat the subject lightly. There is no

shortage of this sort of thing in the textbooks.

Just a word, however, about centrifugal and axial flow compressors. Both units depend to a great extent on the inertia of air in order to compress it, and to do this must depend greatly on high speed operation. The centrifugal unit (Fig. 5 and 5A) treats air as a constantly-replenished body of matter which responds to rotational motion by moving outward from the center of rotation. The farther the matter is spun from the center of rotation, the harder it pushes against anything that tries to stop it; hence, its pressure increases as the air moves to the edge of the wheel. This characteristic permits air to be spun from its original volume to a much

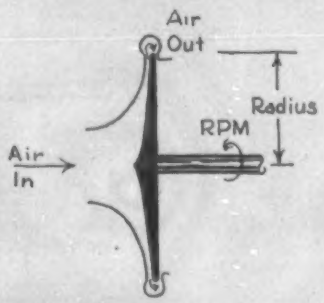


Fig. 5

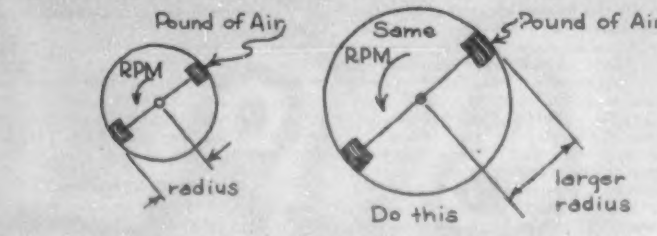


Fig. 5a

smaller volume and a higher pressure as it traverses the face of the centrifugal wheel. Increasing the rotational speed (rpm) or the radius of the wheel (distance from the center of rotation to the rim) will increase the pressure at the rim.

Axial flow compressors (Fig. 6 and 6A) scoop air onto a fast-moving blade — actually, *between* two fast-moving blades — and squeeze it into a stream of smaller cross-section. This accelerates the air enough to ram it into a smaller space, so increases its pressure. Repeating this a number of times yields very high end pressures, but requires non-moving blades to keep the air straightened out and entering the moving blades properly. Increasing the speed of the moving blades or the number of rows of moving blades will increase the final pressure.

fold along this line—outside edges toward you

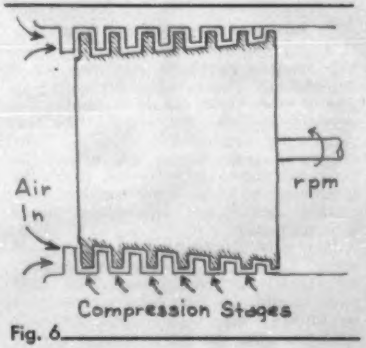


Fig. 6

still utilizing inertia and velocity changes for compression — can get a higher compression ratio than the centrifugal. There is a place for both units and both are still being improved.

Let us examine the effect of component performance on cycle performance, then, from a purely functional point of view. It is true that we must rearrange our concepts of "efficiency" with each change in the cycle, and a good place to start is with compression in the simple open cycle.

What Is Efficient Compression?

Efficient compression is one thing for plant air supplies but quite another for the gas turbine. In plant air supplies "efficient" compression is that which

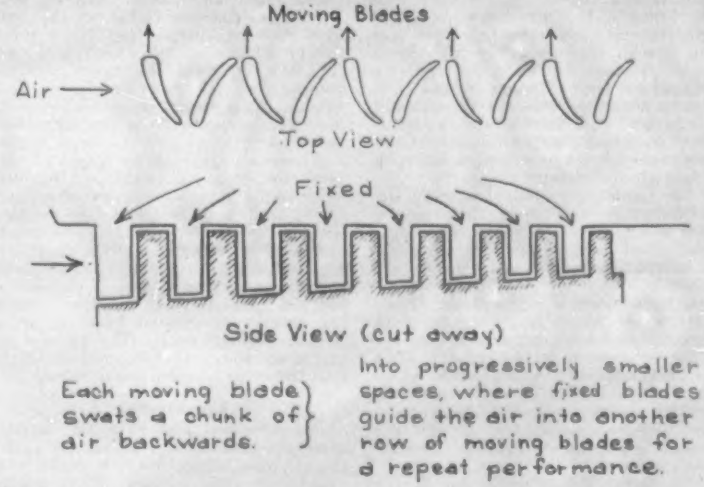

Moving Blades
Air
Top View
Fixed
Side View (cut away)
Each moving blade swats a chunk of air backwards.
Into progressively smaller spaces, where fixed blades guide the air into another row of moving blades for a repeat performance.

Fig. 6a

There is too much technology involved in the design of these two compressors to permit much simplification, but we can satisfy ourselves now by noting their leading characteristics: The centrifugal type is cheaper to build, lighter in weight, and smaller in size than an axial flow type of the same capacity. On the other hand, the axial flow type can do its job more efficiently and — will produce the final pressure with the minimum heating and with the lowest power requirement. In the simple cycle gas turbine, however, we have to worry about the effect on the cycle efficiency as well as compression power. Some heating is not only tolerable, but is actually desirable even though it raises the power requirement for compression of the air.

—cut along this line—

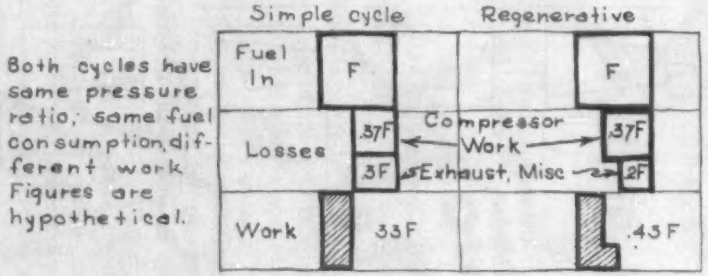


Fig. 11

conditions under which the first serious research was conducted. There were so many other fuel-eaters among the early gas turbines' components that it was quite a while before anyone noticed the terrible combustion efficiency.

To begin with, if all of the air is mixed with all of the fuel at one time, the combustion temperature will never get high enough to support good combustion. As a matter of fact, the flame would probably blow out frequently and have to be re-ignited. Furthermore, the maximum temperature of, say, 1600 F would not be reached until all of the fuel had burned — so the average temperature of the combustion space would be about half-way between the compressed air temperature and the final 1600 F.

Before looking at the answers, let us consider another problem. Air passes through the combustion zone in a very short time, so for virtually the first time engineers had to worry about the time for the chemical reaction (combustion) to take place. If the fuel burned slowly, the flame might very well blow out of the combustion chamber, through the turbine, and out the exhaust. And the speed with which a given fuel will burn is reduced by cooling of the flame; inversely, the speed of combustion is increased by allowing combustion to take place at a higher temperature.

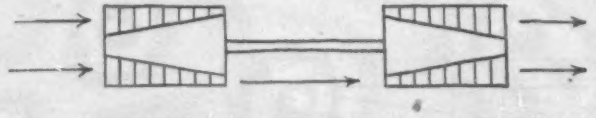
One of the answers, then, becomes obvious. A combustion chamber (Fig. 13) of reasonable size must have a high-temperature zone where ignition of the fuel is assured and where combustion of the larger part of that fuel can take place. This should be at or near the entry point so that the ignition begins properly just after the fuel enters, and the maximum space is left for the slower combustion to take place. This zone of high temperature cannot handle all the compressed air because of the chilling effect; it would no longer be a high-temperature zone. So about 20 to 25 per cent of the air is channeled into the high-temperature zone and the balance of the air is by-passed.

Few materials can withstand the temperature of the primary zone without being cooled. In this case, however, cooling is built in by virtue of the large volume of by-passed excess air. This cooling operation not only keeps the combustion chamber acceptably cool, it tempers the by-passed air so that later admission to the flame zone will not stop combustion or appreciably slow it down. By introducing this air radially inward around the combustion space, the fringes of the flame are cooled and held away from actual contact with the metal walls.

Another major factor that influences burner performance is fuel atomization. The speed with which a particle of fuel can be heated to ignition temperature is proportional to the heat absorbing surface of that particle compared with its volume and weight. The smaller the particle, the more surface it has for its weight and volume; hence, the smaller the particle, the faster it will ignite.

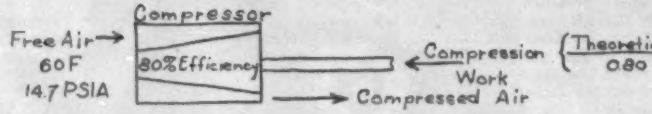
Fortunately, the same factors determine how fast this particle will burn after it has been ignited. The more sur-

fold along this line—outside edges away from you



	Free Air	Compressor	Compressed Air	Turbine	Free Exhaust
A	50 F 14.7 psia	100 % Efficient	465 F 100 psia	100 % Efficient	50 F 14.7 psia
B	50 F 14.7 psia	80 % Efficient	518 F 100 psia	100 % Efficient	110 F 14.7 psia
C	50 F 14.7 psia	80 % Efficient	518 F 100 psia	80 % Efficient	192 F 14.7 psia
D	50 F 14.7 psia	100 % Efficient	465 F 100 psia	80 % Efficient	133 F 14.7 psia

Fig. 7



Pressure Ratio	Temperature Out	Work To Compress 1 lb
10:1	652 F	145 Btu
8:1	579 F	126 Btu
6:1	488 F	104 Btu
4:1	374 F	76 Btu
2:1	205 F	34 Btu

Effect of compression on air temperature in 80% Efficient Compressor (All figures approximate)

Fig. 8

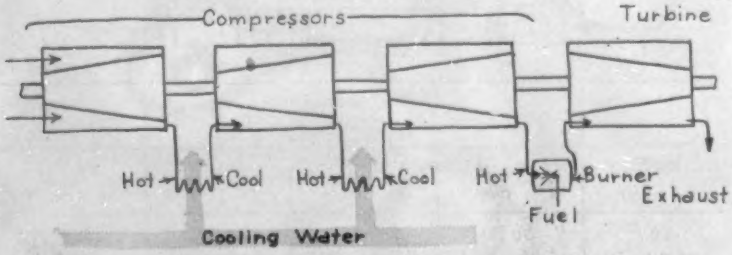


Fig. 9

heat exchange can take place only if there is a difference of temperature. If there is to be any recovery of heat from the exhaust, therefore, the exhaust must be hotter than the compressed air.

This is quite a problem. The simple cycle gas turbine gains efficiency as its compressor outlet pressure goes up. The higher this pressure, however, the higher is the air temperature and the less heat can be removed from the exhaust before the compressed air and exhaust reach the same temperature. In other words, *the higher the compression ratio, the lower the regenerative cycle efficiency.*

If we are to get any of the benefits of high compression, we must resort to the intercooling just described. Proper intercooling removes the stigma from high compression in the regenerative cycle and, while it does nothing to the cycle efficiency by itself, allows the recovery of so much extra heat that the overall cycle efficiency *and* the turbine output increase.

Up to this point, an increase in the maximum temperature only increased the amount of work that could be done by a given turbine. It did not materially increase the efficiency because the waste heat increased as the maximum temperature increased, which resulted in substantially the same ratio of work output to fuel energy input. Now, with the regenerative cycle, the situation is very different.

Since the heat energy that ends up in the exhaust can be recovered, at least above the compressed air temperature, the maximum cycle temperature greatly influences the cycle efficiency (see Fig. 11). The higher the temperature, the higher the efficiency. Now the maximum temperatures that the turbine blade materials can take effect the fuel consumption per horsepower-hour as well as the size of the turbine for a given power output.

Let us back-track in order to make sure that this information is properly understood: *In a properly-intercooled regenerative gas turbine, the higher the compression ratio and turbine inlet temperature, the higher the cycle efficiency.*

Some other interesting facts should be noted about the intercooled regenerative gas turbine. Intercooling reduces the amount of the turbine work that goes into the compressor, and the higher temperatures (if they are permitted) will mean that each pound of air will do more work. Hence, we have a double-barreled saving: We need to compress less air to do a certain amount of work at the shaft, and the air we *do* compress takes less of the turbine power than it would without intercooling. Obviously, intercooling and high temperatures are here to stay — when we can get them.

Why So Much Air?

In the preceding paragraph, reference was made to "each pound of air do (ing) more work." One meaning of this is obvious, and that is that hotter air will work harder to get out of the turbine. Another meaning, not previously discussed, is that the available air is capable of burning more fuel than it previously

fold along this line—outside edges toward you

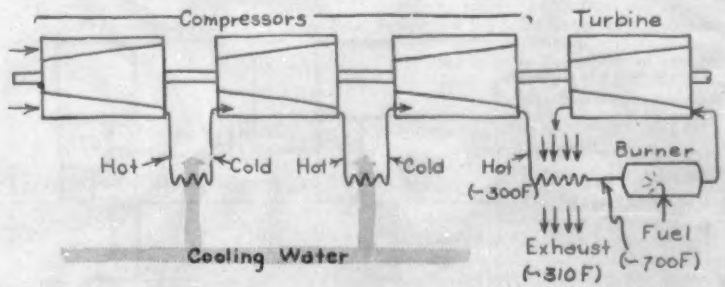


Fig. 10

burned. Obviously, then, we are supplying an excess of air. Why?

Without going into the mathematics of it, let us assume that the theoretical amount of fuel which can be burned in one pound of air would produce a temperature in the combustion products of, say, 3500 F, or 4000 F if the air were compressed to about 500 F first. This would be fine from an efficiency standpoint, but the turbine wheel would melt unless it flew apart first.

So, we run in a lot of air that is not needed to burn the fuel. We only need it to cool the combustion products before they melt down the turbine and to assure good fuel mixing. This is called *excess air*, and is usually expressed as *per cent excess air* or *per cent theoretical air*. Roughly 300 per cent excess air would cool our pound of gas (plus the weight of the fuel) down to an acceptable 1600 F; this would be equivalent to 400 per cent theoretical air. In current practice, excess air runs as high as 600 per cent and is a function of the fuel's energy release and the limiting temperature of the turbine wheel.

The amount of excess air needed in a cycle has a great effect on the cycle efficiency. There are several ways of looking at this effect (Fig. 12). One way is to relate the amount of air to the amount of work done. Remember that a large expenditure of energy is required to get the outside air into the turbine and up to pressure; if each pound of air can burn only part of the theoretical amount of fuel, then we are throwing away much of that "pumping energy" for the sake of cooling. This cuts into the efficiency and demands extra-large compressors.

Another way of looking at it is that we are sacrificing the high efficiencies that go with high cycle temperatures when we use excess air in the regenerative gas turbine.

If we set about stating a general rule for this effect on regenerative cycle efficiency, we find that we have actually said it before: *The higher the* (turbine inlet) *temperature, the higher the efficiency.* We need only add that *the less excess air, the higher the turbine inlet temperature.*

How to Burn Fuel

Until the jet engine came along, and its practical stationary offspring, the business of burning fuel was considered one of the few things we knew *all* about. It turns out that we knew practically nothing — at least, a lot of the things we knew to be true were not. Nero got quite a reputation as a combustion expert, but he couldn't even sharpen the pencils for a modern combustion analysis.

Heat release rates in a modern boiler, burning natural gas or oil, with water-cooled walls, at *peak* operation should not exceed about 60,000 Btu per cubic foot of furnace volume per hour. Heat release in aircraft gas turbine combustion chambers can run anywhere between 1½ to 4-million Btu per cubic foot per hour.

This gain necessarily involved a lot of knowledge derived the hard way and at an urgent rate, considering the war-time

BETZ • *A Great Name In Water Conditioning*

Engineer at work!

If you were to walk into the Engineering Department of our Philadelphia headquarters, chances are you'd see a vacant desk or two like this. And for good reason!

The engineer who occupies this desk might be in Maine, California, Texas . . . anywhere in the country providing supplemental assistance on water problems . . . helping your *personal* representative, the Betz District Engineer and *you* to do a better job in your plant.

He's one of a group of over 20 Betz specialists that make up our fully-staffed Engineering Department . . . providing *additional* headquarters engineering support as well as in-the-field engineering as required.

It is the responsibility of the Betz Engineering Department to carefully analyze the many facets of information concerning your water problems . . . to engineer, interpret, and diagnose the situation as it exists in your plant . . . and to work with the Betz District Engineer to recommend the correct steps to overcome the difficulty.

This *complete* engineering service is another reason why Betz *continues* its leadership in providing sound engineering on all water problems. It will pay you to talk with a Betz District Engineer today. No obligation, of course.

W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa.

In Canada: BETZ Laboratories Limited, Montreal 1.

BETZ

CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

For more data circle 544 on Post Card

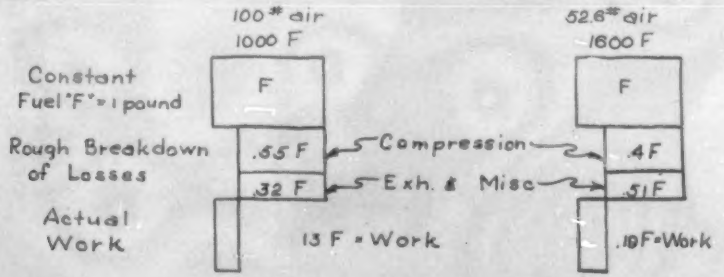


Fig. 12

face area per unit of fuel, the more oxygen can come in contact with each unit of fuel in a given time and the faster combustion heat can spread throughout the droplet. The fuel can be dispersed better throughout the available air supply when it is broken up into small particles. Hence, the finer the fuel is broken up, the faster the ignition and combustion process — and the more even the distribution of heat throughout the air supply.

Natural gas is an extremely popular fuel for gas turbines and, after the preceding discussion, the reasons are obvious. "Particle size" in the case of gaseous fuels implies "drops" as large as the individual molecules. Mixing of these molecules, however, is still necessary to get the fuel molecules next to an oxygen molecule as soon as the fuel is hot enough to do something about it.

So a new factor enters our combustion problem. *Mixing* or the even dispersal of fuel throughout the available air influences the speed with which combustion can be completed. After all, a lot of hot fuel molecules or drops accomplish nothing until they meet and join oxygen and release a little heat of their own.

In many of the burners used today, engineers have killed two birds with one stone by atomizing the fuel with compressed air. Not only does this break up the fuel to a maximum-surface-area condition, it does some preliminary mixing and even gives some preliminary "swirl" to the fuel-air mixture. Swirling combustion with extra air coming inward radially from the combustion "can" tends to throw the unburned particles out of the space in which a lot of oxygen has been used, and into the space around the edges where the fresh air is coming in with a high relative velocity. This "scouring" of the burning stream with fresh air improves the odds that the fuel will find oxygen. The 20- to 25-per-cent quantity of air entering the high-temperature zone is deliberately given this swirl in many burners by a set of fixed "propellor" blades in the entry port.

Another, though possibly less important, factor in favor of swirling combustion is a matter of pure geometry. The cork-screw, turbulent path followed by fuel through the burner means that (for a given air-fuel speed) a fuel droplet will be in the burner longer because it travels farther. Hence, the urgency of gaining fast combustion is reduced somewhat.

Solid-Fuel Combustion

Two avenues hold promise for the gas turbine. One is the extremely high efficiences which seem possible with the "expensive" fuels, oil and gas, and which are contingent on intercooling, regeneration and high turbine inlet temperatures. The other is the utilization of coal fuels, even with the efficiencies common today.

Some rather interesting problems come up when coal is burned in the gas turbine, and most of them have to do with ash. If ash could be removed from coal *before* burning, the situation would be much the same that we have with oil fuels. As it is, we must remove ash after

fold along this line—outside edges toward you

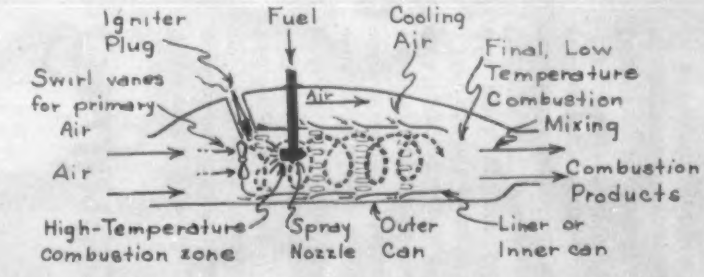


Fig. 13

combustion is as nearly complete as possible or a lot of the combustible carbon will stick with the ash and be lost.

Ash passes through three troublesome phases as coal burns in a very hot flame. First, if the flame is hot enough, it vaporizes and passes as a vapor into the turbine. As it condenses, or if it does not vaporize, it becomes a sticky substance that will build up in the air passages and /or the ash separating apparatus. After it has cooled down enough to lose its stickiness, it becomes an extremely abrasive powder that cuts away metal parts much as a sand-blaster would do it. Nothing but trouble.

These problems are being solved through very careful design compromises in the combustion chamber and some excellent design in the ash separating apparatus. To begin with, it is still important to keep particle size extremely small if combustion is to be fast enough and temperature distribution is to be controlled. Finely pulverized coal, however, means finely pulverized ash — which is very difficult to separate from a gas. This fine ash softens (or vaporizes) more rapidly than larger particles because of the high surface area through which it absorbs heat into a small volume.

So the combustion chamber must provide some method of keeping the ash away from the metal walls and chilling this ash to a non-sticking temperature. Both, fortunately, are accomplished by careful introduction of the excess air along the burner walls. More excess air may be required in such an engine than an oil or gas burning unit if the ash fusion (softening) temperature is lower than the limiting temperature of the turbine blades.

Assuming that combustion is completed without depositing sticky ash throughout the combustion chamber, and at the expense of more excess air, there is still the abrasive ash to contend with. This must be removed before it gets into the turbine inlet or it will cut out the stationary blades that direct the hot gas into the turbine (more about these later). It might even cut out some of the turbine blades.

Besides the pulverized coal burner just described, there are plans to burn coal in a completely pressurized stoker, to manufacture producer gas out of the coal and burn that in the turbine, and to use burners which melt down all the ash and trap the slag. All of these schemes hold promise, but the one described is farther advanced.

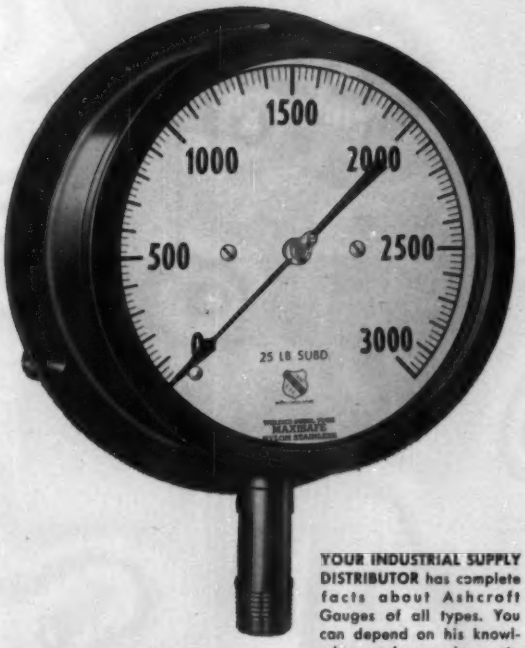
This "primer" discussion is not sufficiently detailed to go further into coal burning, but one more point should be made. Turbine inlet temperatures are limited in such units more by the ash fusion temperature than by the turbine blade materials. Since none of the ash separators are perfect, or promise to be, it is likely that this limitation will stand for a long time. The coal burning turbine will probably continue to compete, therefore, on a cost-of-fuel basis rather than efficiency.

Turbine and accessory sections and gas turbine applications in other cycles will be discussed in following issues.

Power Plant Theory and What It Means
Section 1

EASY TO SERVICE...

a plus value of ASHCROFT *Maxisafe* DURAGAUGES



Turn the knob on the back of the *Maxisafe* and the plate comes off, fully exposing the entire mechanism for fast and easy inspection, recalibration or adjustment. This time and money-saving feature is highly favored wherever Ashcroft *Maxisafe* Duragauges are in service.

This Duragauge was named *Maxisafe* because it has an integrally-cast wall to separate the dial from the movement and Bourdon Tube assembly — a solid wall of safety that protects the viewer if the tube ever ruptures. Covering the back of the case is a double spring mounted safety release plate — a Teflon-coated plate tightly fitted on a rubber gasket and held in place by a knurled knob. Less than 0.5 psi pressure created by a ruptured tube forces this cover open — vents the discharge safely to the rear.

The Maxisafe is available in 4½", 6" and 8½" dial sizes. You can have a choice of standard Ashcroft Duragauge pressure ranges, case designs (except Types 1179 and 1279), and mountings. Get the utmost in sustained accuracy, durability, protection and convenient servicing. Specify Ashcroft *Maxisafe* Duragauges.

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR has complete facts about Ashcroft Gauges of all types. You can depend on his knowledge and experience to help you satisfy every requirement of the application. He maintains local stocks to serve you promptly and economically.

1850 ASHCROFT U.S.A.

ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'ASHCROFT' GAUGES, 'AMERICAN' AND 'AMERICAN-MICROSEN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

For more data circle 545 on Post Card

GREEN

FOR FIFTY YEARS

Specialists

IN IMPORTANT STEAM PLANT EQUIPMENT

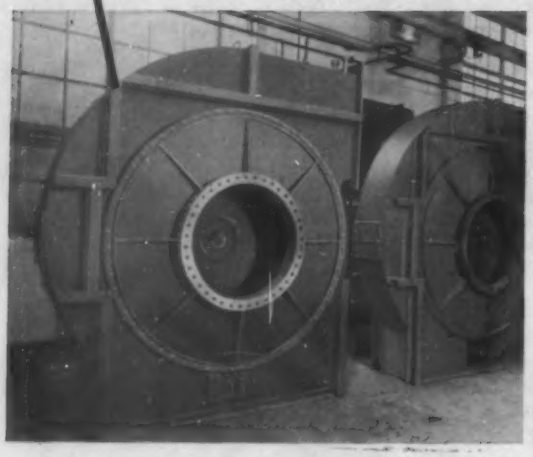
FORCED AND INDUCED DRAFT FANS

Complementing our several designs of GALEX Airfoil Type Draft Fan recently described is an extensive line of various types of fans with forwardly curved, straight radial, or backwardly curved blades. Thus, we are in position to offer soundly engineered fans for any draft requirement. The GALEX Fan, introduced by us in this country back in 1916, has been modernized and broadened in application particularly to take care of the more selective pressure-volume combinations required by today's boiler plant operations.

For problems of Fly Ash Control, we offer the Aerodyne Collector which is producing exceptionally gratifying results in some of the largest utilities in the country. Because of its positioning flexibility and adaptability to existing flue systems we suggest that you consider its use in connection with your fly ash problem.

Yes, on Draft Fans and Fly Ash Collectors, we are in a strong position to help you take care of your requirements . . . with years of experience to back up our recommendations.

FLY ASH AND DUST COLLECTORS



GREEN
POWER AND PROCESS PLANT EQUIPMENT

GREEN THE AIRFOIL TYPE FAN galex FAN

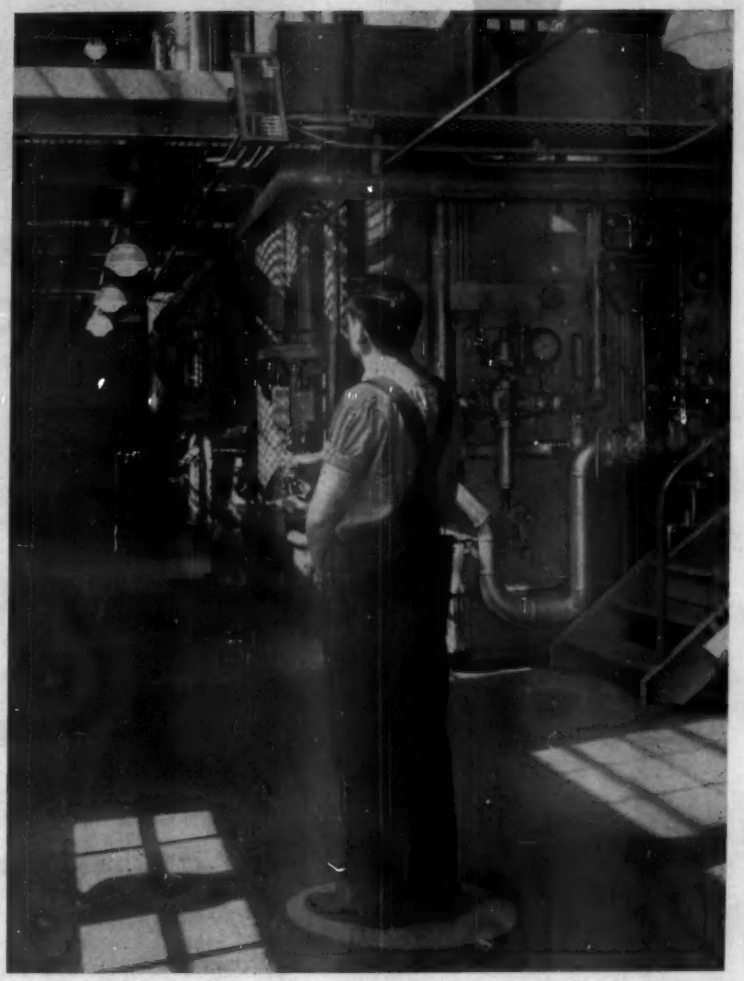
NEW YORK • CHICAGO • DETROIT
Representatives in Principal Cities

FUEL ECONOMIZER COMPANY,
BEACON 3, NEW YORK

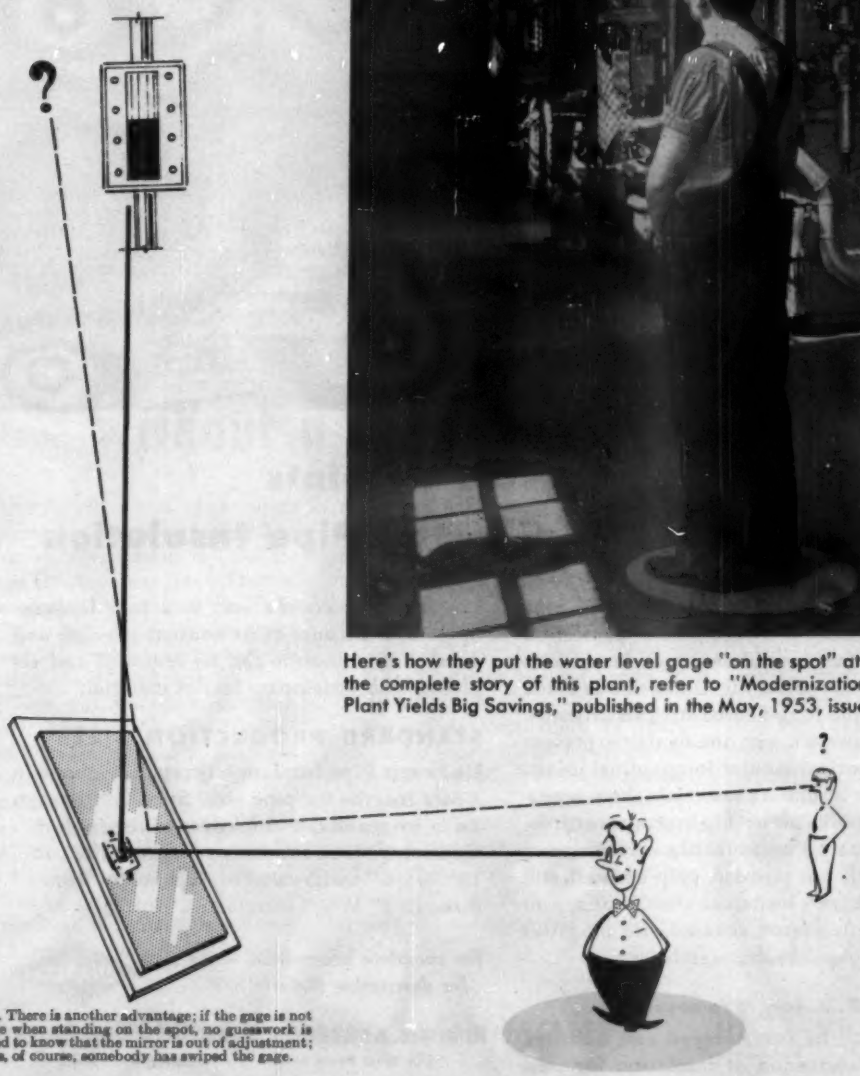
For more data circle 546 on Post Card

Water Level on the Spot

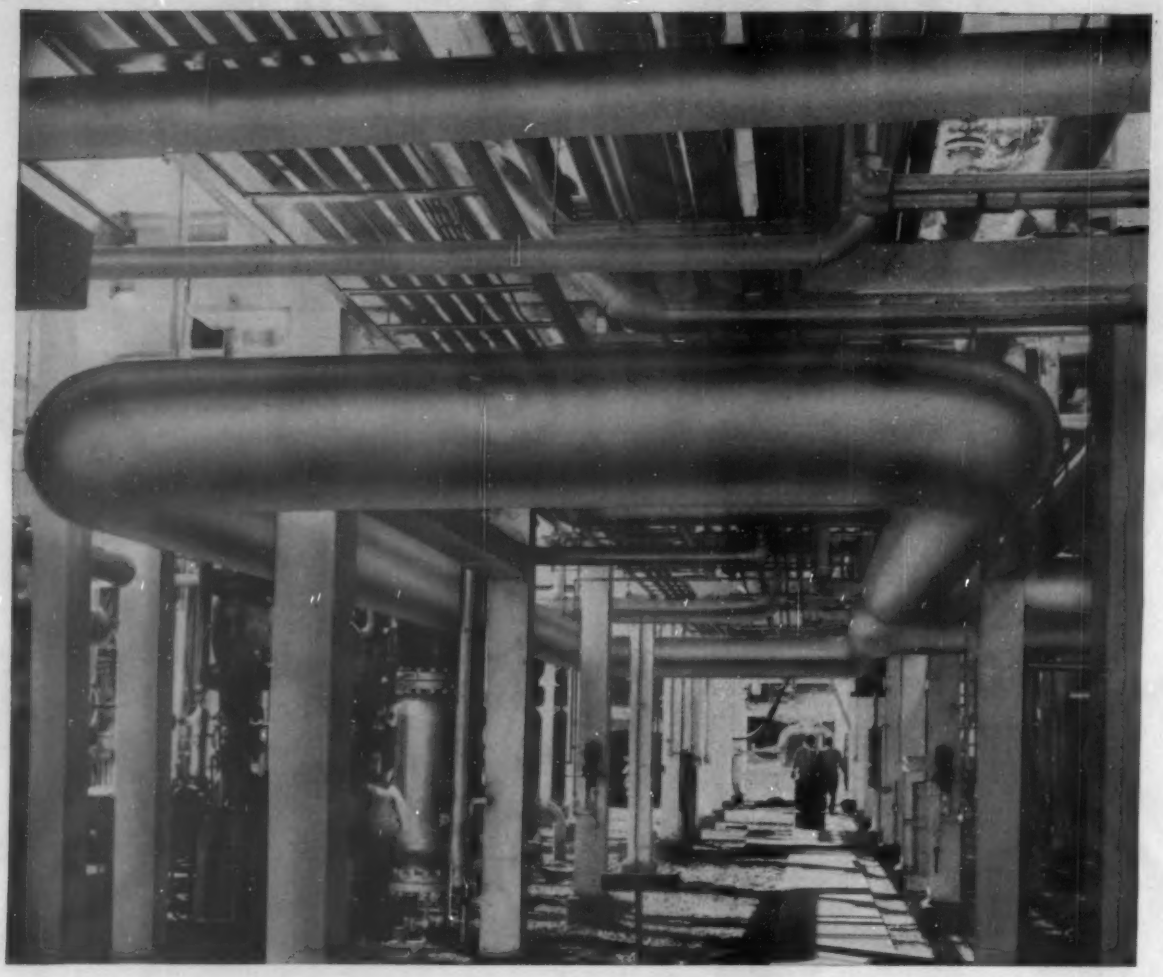
ANYONE WHO HAS EVER maneuvered around a boiler room floor trying to line up the gage glass in an observation mirror will appreciate the practicality of the idea pictured here. Personnel of the Power Plant at the Hawthorne Works of Western Electric Co., tired of circling around like bird dogs on a scent whenever they wanted to check water level, painted yellow spots on the floor at the exact location where a man should stand to line up the water level gage in the observation mirror.*



Here's how they put the water level gage "on the spot" at Hawthorne Works. For the complete story of this plant, refer to "Modernization of Hawthorne Power Plant Yields Big Savings," published in the May, 1953, issue of POWER ENGINEERING



* P.S. There is another advantage; if the gage is not visible when standing on the spot, no guesswork is needed to know that the mirror is out of adjustment; unless, of course, somebody has swiped the gage.



Less heat loss at joints with single-layer Unibestos® Pipe Insulation

Tests prove that Unibestos single-layer pipe insulation actually provides greater protection than other nonfibrous *double-layer* insulations which cost more to install. Unibestos is made of Amosite—the long-fibered African asbestos. These fibers interlock with one another to prevent heat loss at horizontal and longitudinal joints.

While most insulating materials show a pronounced shrinkage at high temperatures, Unibestos has no measurable shrinkage at 1200°F. It will not powder, pulp or wash off, even under heavy moisture conditions, and when dry, Unibestos resumes its original thermal and physical characteristics.

EASY to install . . . easy to remove.

Unibestos can be cut, mitered and handled easily. The fabrication of insulation for tees, valves, flange covers, etc., is a fast, low-cost operation. Because of its unusual strength and durability Unibestos can be removed and replaced with little or no loss of material.

STANDARD PRODUCTION SIZES

Unibestos Pipe Insulation is regularly made in 3-foot lengths for pipe sizes from ½″ through 24″, in standard thicknesses through 5″. Unibestos Block Insulation is made in 6″, 12″, 18″ or 36″ widths and in thicknesses from 1″ through 3″ in ½″ increments.

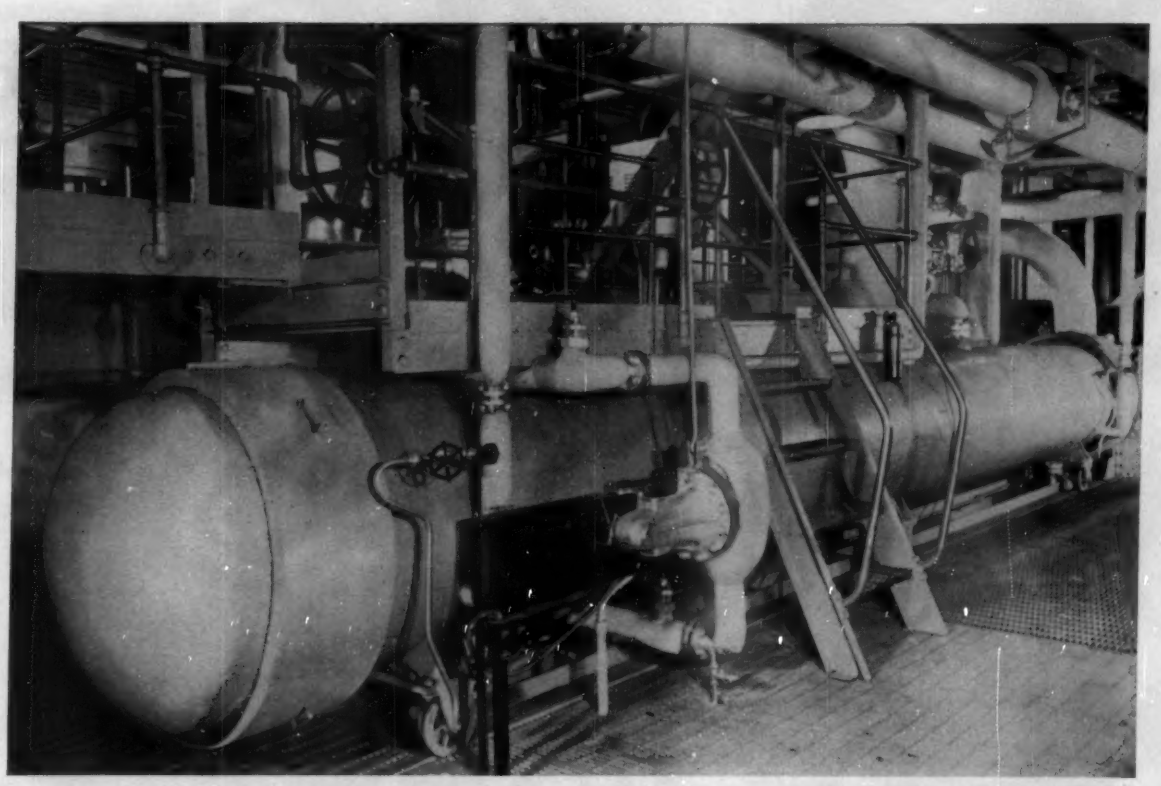
For complete information, write for descriptive Bulletin 109C

UNARCO

UNION ASBESTOS & RUBBER COMPANY

1111 West Perry Street • Bloomington, Illinois

For more data circle 547 on Post Card



Installed in 1941 this cross-over feedwater heater is one of two Monel-tubed units that feed a boiler generating 2,500 psi steam at 1,000°F. Still in first class condition, these pioneer heaters continue to serve American Gas & Electric at Twin Branch, Ind. Both heaters were built by Foster Wheeler Corp.

Monel tubes feed 490° water at 3,200 psi without a replacement in 14 years

14 YEARS AGO there was no precedent for feeding high pressure boilers that generated 2,500 psi steam at 1,000°F.

When The American Gas & Electric System decided to extend its Twin Branch station, designers were not even sure of what heater tubing material they could safely use.

For here was a project requiring feedwater heaters to handle 550,000 pounds of water per hour at 3,200 psi maximum . . . and to raise water temperature from 355° to 490°F.

After much searching and testing, engineers found that one tube material —Monel* nickel-copper alloy—offered more than ample strength to withstand both the heat and pressure. Monel tubes offered corrosion and erosion resistance that assured this high strength over years of use. At the same time, this alloy also assured rapid heat transfer.

So American ordered two heaters from the Foster Wheeler Corporation . . . each to have 316 Monel tubes of ¾" O.D. with a heating length of 29 feet.

Since their installation, 14 years ago, not a single Monel nickel-copper alloy tube in either heater has been plugged or replaced. Moreover, there's been no unscheduled downtime for repairs because of tubes. In February 1955, American Gas & Electric reported "... the Monel tube bundles are in good condition and should last indefinitely."

This performance is good reason why you, too, should use Monel tubing . . . for excellent strength, corrosion and erosion resistance, and a coefficient of expansion close to that of steel tube sheet.

You can order Monel tubing in lengths up to 85 feet. Get all the facts about Monel nickel-copper alloy. Send for a copy of Inco's T-5, "Engineering Properties of Monel." Write for it now. *Reg. Trademark

The International Nickel Company, Inc.
67 Wall Street New York 5, N. Y.

50 YEARS OF Nickel Alloy Progress PIONEERED BY MONEL 1905 · 1955

More POWER for you...with MONEL

INCO TRADE MARK NICKEL ALLOYS

For more data circle 548 on Post Card

MAKERS OF JOHNSON WAX PRODUCTS TELL ABOUT THEIR VIBRA-GRATE

Administration and Research Center, S. C. Johnson & Son, Inc., Racine, Wisconsin. In the foreground is a giant plastic globe which serves as a directory of the company's world-wide operations.

TWO YEARS AGO, S. C. Johnson & Son, Inc. was in the market for a stoker for their Racine plant. Impressed by the advantages of the Vibra-Grate (which AE had been licensed to build in U.S. and Canada) Johnson engaged a German consulting engineer to investigate a number of European installations. These included Vibra-Grates in service since 1947, and earlier models dating back to 1939. Johnson instructed American to proceed with the work immediately, subject to the engineer's report which, when received, confirmed Johnson's decision. Their comments after the unit had carried the plant load to May, 1955, will interest everyone seeking maximum stoker efficiency and economy.

"We put our Vibra-Grate Stoker in service in October 1954 and it has frequently carried loads of 45,000# steam per hour, its rated peak capacity, and has often operated at loads of 10,000 to 15,000# per hour.

"We have found no objectionable fly ash at any rating and tests have shown that the quantity of solids entering the stack is far below those specified in the ASME Smoke Regulation Ordinance and our local codes. The Vibra-Grate was installed without a dust collector and it is obvious that no collector is needed.

"Comparison of the operating efficiency of the Vibra-Grate with that of our former stoker is very much in favor of the Vibra-Grate. Need for maintenance has been at an absolute minimum."

AE Vibra-Grate Stoker (completely water-cooled) brings a combination of advantages never before approached in stoker history. Nearly 100 Vibra-Grates are now in operation in Europe, the Middle East and the U.S. If you are shooting for the last word in stoker efficiency, write us for full information.

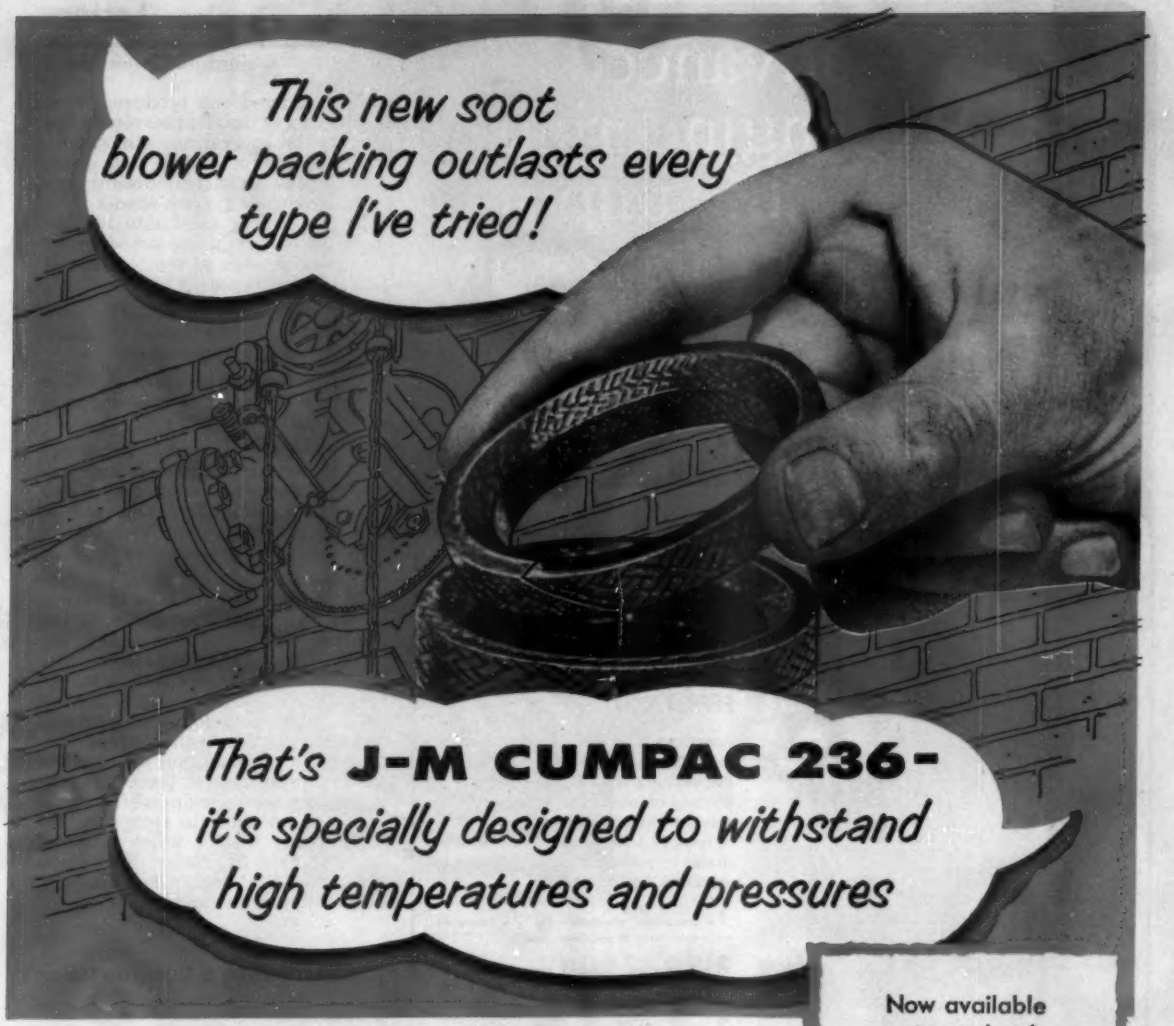
AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25, PENNA.

Affiliated Engineering Corporations, Ltd., Montreal 16, P. Q., Bawden Industries, Ltd., Toronto 3, Ont.

AE Products are: Marine Deck Auxiliaries, Hele-Shaw and Hydromite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers, Taylor, Perfect Spread and Vibra-Grate Stokers

For more data circle 549 on Post Card


This new soot blower packing outlasts every type I've tried!
That's J-M CUMPAC 236- it's specially designed to withstand high temperatures and pressures

Now available at your local Johns-Manville Packing Distributor

saves time and trouble ... reduces expensive soot blower repacking

YOU MAY HAVE ALREADY discovered that traditional soot blower packings cannot withstand the higher temperatures and pressures employed in boiler operation today. Now, Johns-Manville brings you a new packing specially developed for this service. Cumpac 236 won't harden or vulcanize and greatly outlasts all other packings of the conventional types.

In plants where it has already been introduced, users report excellent results. Soot blower repacking has been reduced to a substantial degree.

How it is constructed: Cumpac 236 resists high temperatures and pressures because it is specially made of high purity asbestos yarn braided over a plastic core of special heat-resistant composition and lubricated with mica. This material is formed into a combination of lip type and solid packing which provides low friction contact with the soot blower tube and seals the entire stuffing box.

Your J-M Packing Distributor carries No. 236 Cumpac sets for all popular soot blowers. He also stocks other Johns-Manville Packings and Gaskets. Ask him for the Cumpac 236 folder, PK-100A, or write Johns-Manville, Box 60, N. Y. 16, N. Y. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

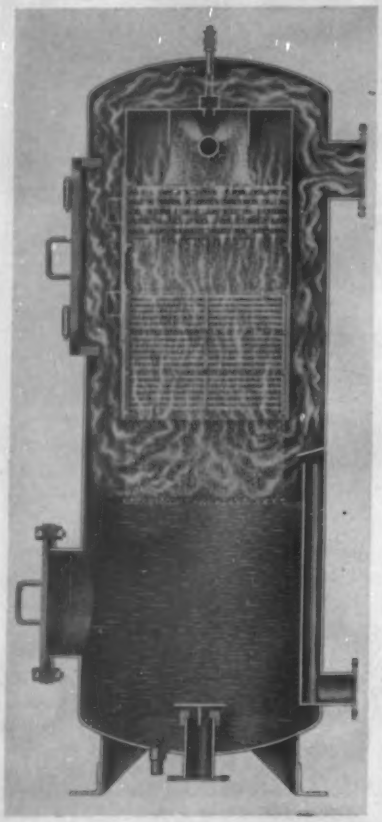
For more data circle 550 on Post Card

ON WATER CONDITIONING CONSULT AMERICAN ... first

advanced engineering is the important factor in

AMERICAN

water conditioning service



AMERICAN TRAY DEAERATORS

DESIGNED FOR BEST POSSIBLE EFFICIENCY

American Tray Deaerators are made in all types and shapes for any possible working conditions. Over a half century of experience in successfully solving water treatment problems is in back of American Tray Deaerator design — and included are these outstanding American Features:

1. Deaerator compartments are separate units fabricated of stainless steel.

2. Only clean incoming steam and deaerated water are in contact with the pressure vessel shell.

3. Air separating trays have 50% more spillage edge and 100% more open passage than similar trays.

4. Counterflow operation gives greatest possible deaerating action by sweeping contaminating non-condensibles back to the vent condenser.

A successful deaerator installation depends upon the perfection of details. In American designs only those components are used which are leaders in their field and consideration is given to assure that all these accessories operate smoothly and "fail safe". Our engineers are ready to study your requirements. Write for Bulletin 402.

SERVICE SINCE 1902 TO THE INDUSTRY

AMERICAN Water Softener COMPANY

INCORPORATED

FOURTH AND LEHIGH AVENUE • PHILADELPHIA 33, PENNSYLVANIA

DEAERATORS • HOT PROCESS SOFTENERS • REACTORS • FILTERS • ZEOLITE SOFTENERS • CHLORIDE DEALKALIZERS • ACTIVATORS & DECARBONIZERS HYDROGEN-SODIUM ZEOLITE SOFTENERS • DEMINERALIZERS • CHEMICAL FEEDERS • CONTINUOUS BLOWDOWN • SWIMMING POOL EQUIPMENT

For more data circle 551 on Post Card

Letters

continued from page 4

finely powdered ash produced from the burning of the 60 mesh coal in the open dish in an oxidizing atmosphere was generally of a light tan color, with some ashes varying toward purplish, pinkish or grayish shades.

In the electric ash-fusion furnace operating with reducing atmospheres, the colors of cones at temperature of point of determination of the:

(a) Initial deformation, ID, were light brown. The surfaces of the cones were vitreous in appearance.

(b) Softening temperature, AST or SP, were brown. The cone surfaces were glazed.

(c) Liquid or fluid point, FP, when the entire cone disappeared and was wholly absorbed as a liquid slag into the white ceramic base, the color of the flat residual stain was totally black. The surface was glassy.

This confirms the effect of the "solution" of the iron oxide as the agent of color in the liquid phase of the reaction as even more important than the effect of the reducing atmosphere.

In molten slags, as seen with the cyclone coal furnace or the molten mass of ash sometimes encountered in stoker furnaces, the ferrous iron blackens the ash, when dissolved in the liquid portions of the ash. These laboratory tests were purely corroborative as an effort to reproduce the field results with a wider range of coals. — *Fred M. Reiter, Fuel Engineer, Ray E. Novak, Chief Chemist, The Dayton Power and Light Co.*

Handstoning a Commutator

To the Editor:

IN NOVEMBER 1954, you published an instructive article entitled "How to Handstone a Commutator" by R. L. Tauscher. I would appreciate more information about the following points discussed in the article.

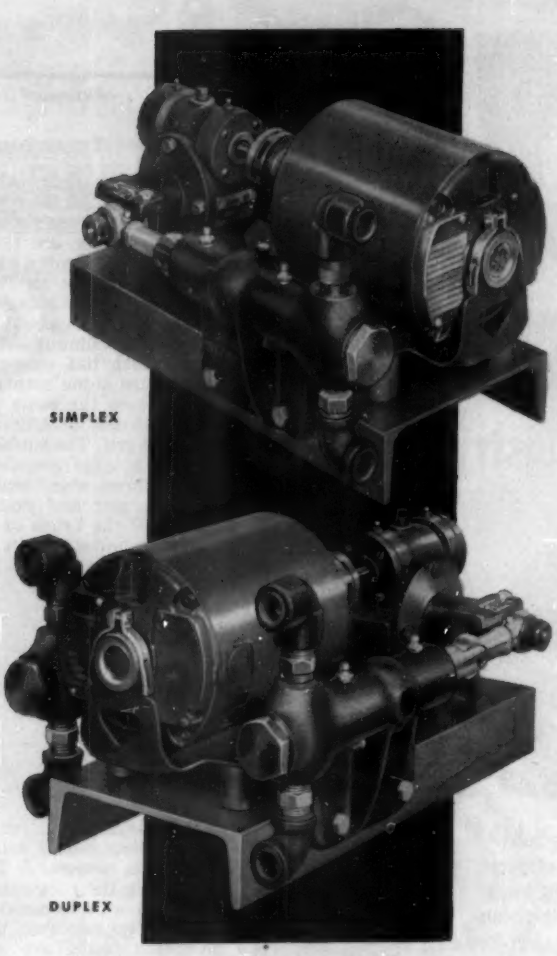
1. What is Axolite cloth? Is it the material that used to be sold under the name of Crocus cloth?

2. What is a rubber base stone and how is it made?

3. You mention in the article that 120 grit stone is rather common. I tried to get this stone from several sources, such as Carborundum, Norton, etc., but in each case was referred to Ideal Industries. Why should a common stone be unavailable from these companies, and why should it be available only from Ideal Industries?

4. What is the maximum pressure that should be used for blowing out the machine?

5. How do you know when the commutator bars should be beveled? And how do you do the beveling for a high-speed commutator when it is necessary? — *M. L. R.*



Proved! Low cost!

Milton Roy Controlled Volume

H-20 PUMPS

for accurate, dependable water-treating service

THE Milton Roy H-20 Controlled Volume Pump provides simple, inexpensive chemical metering for treatment of boiler water and for other general purpose water and waste treatment systems. H-20 Simplex and Duplex units offer repeatable metering accuracy plus extra economies, from low first cost . . . through installation and operation.

Liquid end design employs double ball-check valves in a vertical column. Packing is spring loaded from the front end. Both valves and packing are simple and inexpensive to replace.

Standard drive is by constant speed ⅓ hp electric motor. Variable speed, three-phase, totally enclosed, or explosion-proof motors are also available.

Capacity regulation is easily accomplished manually or automatically.

Conversion from Simplex to Duplex, or vice versa, can be done in the field.

Standard models are available in stock for immediate delivery. Capacities to 28 gph (Simplex). Pressures to 600 psi.

Hydrazine addition . . . other advanced techniques

Where Hydrazine is used to scavenge residual oxygen, precise feeding of the chemical is required to maintain oxygen content at zero. This is a job demanding controlled volume pump precision.

For detailed technical discussion of "*Controlled Volume Pumps For Water Treating Systems*," send for Bulletin 953. Just off press, this 24-page bulletin contains clear text, illustrations, and diagrams on all the latest applications, including Hydrazine addition to boiler feedwater.

Engineering representatives in the United States, Canada, Mexico, Europe, Asia, South America, and Africa.

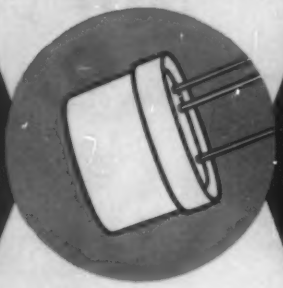
FOR DETAILS

send for Bulletin H20-1.
Milton Roy Company,
Manufacturing Engineers,
1300 E. Mermaid Lane,
Phila. 18, Pa.

milton Roy
CHEMICAL FEED SYSTEMS

For more data circle 552 on Post Card

This Mighty MITE serves an industry



The transistor, replacing bulky vacuum radio tubes, is a product of millions of engineering hours. Precision production of this miniature marvel depends upon controlled temperatures.

The innate thermal insulating efficiency of Mundet Insulations is constantly aiding the electronic industry in the manufacture of precision equipment and components.

Whatever industry you are in, Mundet thermal engineers are available for consultation on your specific problems in temperature control. Coupon brings latest catalog on Mundet Insulations and contract installation services.

There's a Mundet Office near you

ATLANTA, GA. 339 Elizabeth St., N.E.
BALTIMORE, MD. 2606 Hafer St.
CINCINNATI 2, OHIO 427 West Fourth St.
DETROIT 38, MICH. 14401 Prairie Ave.
HOUSTON 11, TEXAS 6601 Supply Row
JACKSONVILLE 2, FLA. 800 East Bay St.
KANSAS CITY 1, MO. 1210 West 9th St.
LOS ANGELES, CAL. (Maywood) 6116 Walker Ave.
NEW ORLEANS 16, LA. 315-325 North Front St.
NEW YORK 17, N. Y. 331 Madison Ave.
PHILADELPHIA 39, PA. 856 North 48th St.
SAN ANTONIO 130 Lombrano St.
ST. LOUIS 5, MO. 3176 Brannon Ave.
SAN FRANCISCO 7, CAL. 440 Brannan St.

In Canada: Mundet Cork & Insulation Ltd. 35 Booth Ave., Toronto

MUNDET CORK CORPORATION
Insulation Division
7115 Tonnelle Ave., North Bergen, N. J.

Without obligation, send free copy of loose-leaf Mundet Insulation Manual and full information on Mundet Tri-Calite Heat Insulation.

NAME.....

FIRM.....

ADDRESS.....

Mundet Insulation Products include: "Custom-Molded" 85% Magnesia Pipe Covering; Magnesia Blocks and Segmental Covering; High Temperature Pipe Covering and Blocks; "Jointite" Cork Pipe Covering and Corkboard... for all temperature ranges.

MUNDET

For more data circle 353 on Post Card

Letters

continued from page 110

Tauscher Replies

1–2. Aloxite and Alundum are trade names for a type of cloth used in polishing commutators. These polishing clothes are not the same as those sold under the name of Crocus cloth. Crocus cloth is generally used for polishing steel shafts, for example, and should not be used for polishing commutators. I believe Crocus cloth has emery in it. The rubber base stone mentioned in the article serves the same general purpose as Aloxite or Alundum cloth of about 240 grit. The rubber base stone contains a large amount of rubber with an abrasive and sealer. It cleans like an eraser and does not affect the face of the brush or cause filling of the commutator slots. It is sometimes described as a flexible abrasive.

3. I do not know why the 120 grit stone is available from only a few manufacturers. The Ideal Industries are mentioned as one possible supplier of this 120 grit stone. The American Emery Wheel Works in Providence, R. I. also supplies this type of stone.

4. A suitable pressure for blowing out a machine after handstoning is 70–90 lbs. per sq inch. Too high a pressure can damage a machine.

5. A visual inspection of the commutator bars should determine when beveling is necessary. The purposes of beveling the commutator bars are (1) Remove burrs caused by a stone dragging copper over the slots. (2) Eliminate the sharp edge at the entering side of the bar, under a brush. (3) Assure against mica slivers adhering to the side of the bar. Beveling of the commutator bars can be accomplished by using a hacksaw blade ground to have a sharp hooked edge on the end and drawing this blade along the bar. The beveling should be about $\frac{1}{32}$" chamfer at 45°, for medium thickness of bars. For thinner or wider bars, the beveling can be changed accordingly.

NEW ENGINEERING BOOKS

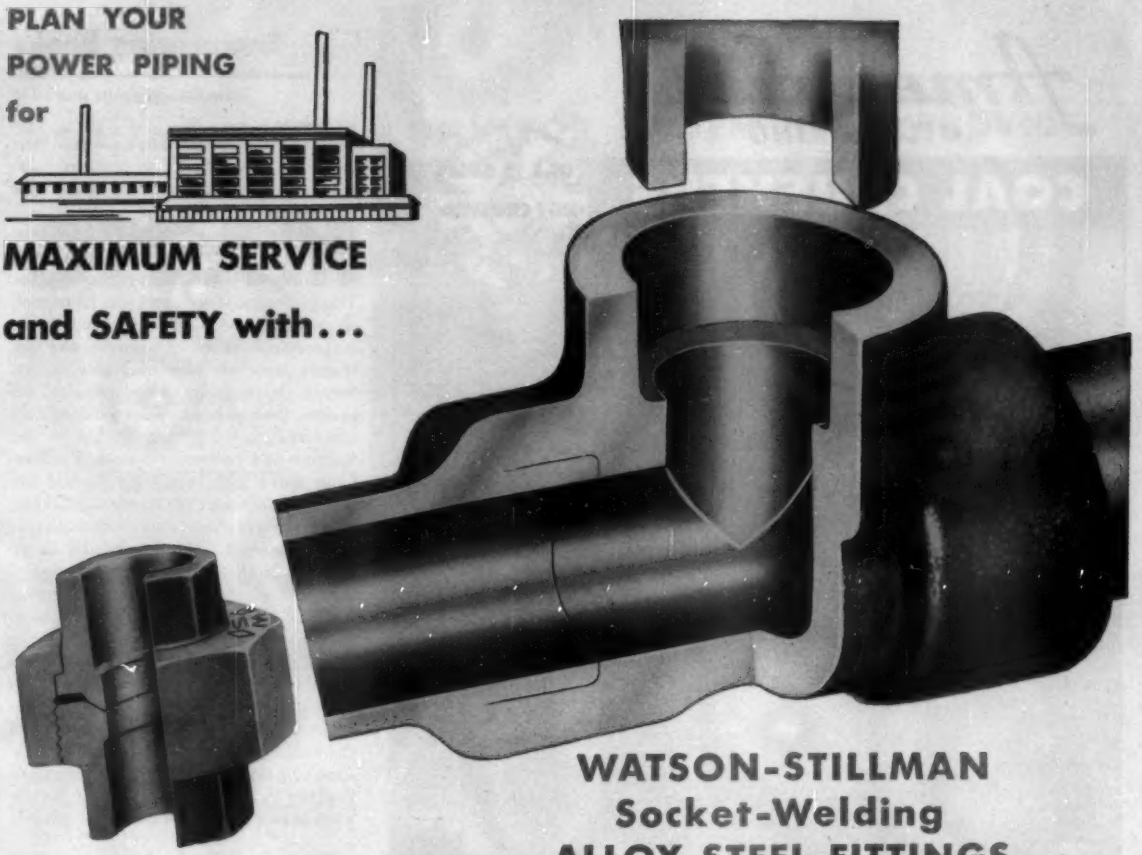
Transient Analysis of Alternating Current by Waldo V. Lyon. First Edition, 310 pages 6¼ by 9¼ in., John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Price $7.00.

The product of more than twelve years of research and reflection, this book offers the first systematic application of Fortescue's methods of symmetrical components to the solution of transient conditions in AC machinery.

The method has long been an indispensable tool in the analysis of the unbalanced

PLAN YOUR
POWER PIPING
for

MAXIMUM SERVICE
and SAFETY with...



WATSON-STILLMAN
Socket-Welding
ALLOY STEEL FITTINGS

1¼% Cr–½% Moly **2¼% Cr–1% Moly**

Watson-Stillman Socket-Welding Pipe Fittings provide strong, tough trouble-free joints for high pressure, high temperature steam piping. W-S high quality forged alloys are available to meet the severest conditions. They have excellent dimensional stability, good corrosion resistance and freedom from graphitization—three basic properties necessary for safe, reliable operation at high temperatures and pressures. In addition, the fibrous metallurgical structure of W-S drop-forged fittings provides extra strength and toughness to resist shock and vibration.

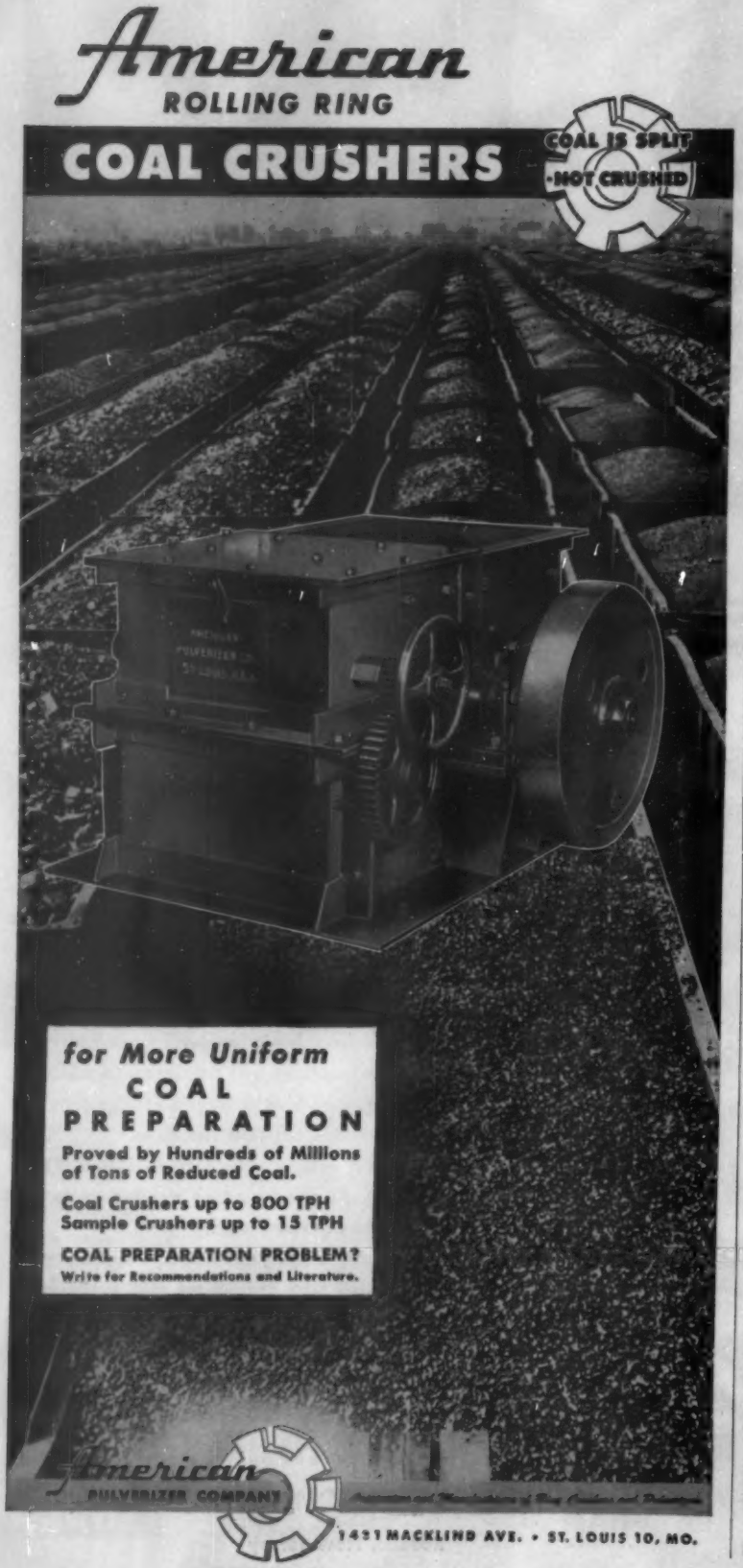
Watson-Stillman Socket-Welding Fittings are easy to install. Deep sockets support and align the pipe. No need for tack welding or special fixtures. Just slip the fitting over the pipe and weld.

Watson-Stillman also manufactures a complete line of Forged Screw-End Fittings in the above alloys. All W-S fittings are also available in carbon steel and in several grades of stainless steel.

Write for information today.

WATSON-STILLMAN FITTINGS DIVISION
H. K. PORTER COMPANY, INC.
Roselle, New Jersey

For more data circle 554 on Post Card



For more data circle 535 on Post Card

Engineering Books

continued from page 112

operation of polyphase machines and their connected networks. Its applications, however, have been confined to the steady state behavior of machines. The resolution into symmetrical components has involved the complex representation of alternating currents and potentials and the system constants. Though Fortescue was aware that his method of resolution could also be applied to the instantaneous values of currents and potentials, there has been until now no systematic development of this phase of the analysis. Basing his analysis on the Kirchhoof differential equation that applied to the machine and connected system, Professor Lyon shows how Fortescue's method can be used to determine the transient behaviour of polyphase machines under different operating conditions. Of great interest to all concerned with the design and operation of AC machines and their connected circuits, this book fills an important place in the complete library of electrical technology.

Professor Lyon has been associated with the Massachusetts Institute of Technology during his entire career and, at present, holds the title of Professor emeritus of electrical machinery at MIT. A fellow of the American Institute of Electrical Engineers, Professor Lyon is widely known for his writings on the subject of electrical machines.

★ ★ ★

50 Years on Tracks, published by the Caterpillar Tractor Co. Size 9 by 11½ in., 104 pages, illustrated, cloth binding. Copies available at Caterpillar dealers for approximately $1.25.

This is a nostalgic treatise prepared by the Caterpillar Tractor Co. in commemoration of the fiftieth year of the crawler tractor; it is also, incidentally, a corporate history of Caterpillar and its contribution to the development of these hardy, versatile machines that go anywhere, do everything.

The book presents a heavily illustrated story of the growth of the crawler tractor from Benjamin Holt's first wooden-tracked machine in 1904 to today's diesel-powered bulldozers and carry-alls. Of especial interest are the photographs of early steam tractors and farm machines, some of which are 60 years old and depict gargantuan mechanical monsters for harvesting the great wheat fields of the West.

It seems a pity, however, that the book makes only a passing reference to that greatest of all tractor salesman, Alexander Botts of *Saturday Evening Post* fame. William Hazlett Upson's hero has probably done more to make the populace tractor-conscious than anyone else, in the business or out of it, and certainly deserves better of Caterpillar than he has received in "50 Years on Tracks."

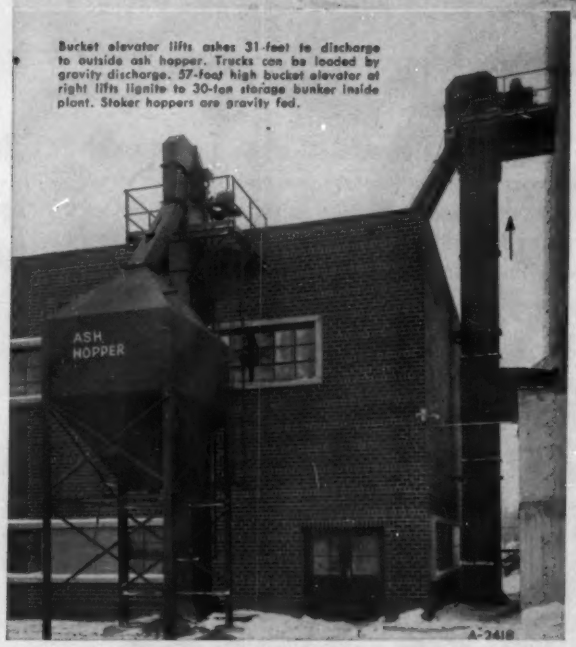
However, aside from this omission, the book is informative and interesting.

S-A ENGINEERED CONVEYOR SYSTEM HELPS PROVIDE

STEAM from LIGNITE

FOR NORTH DAKOTA STEAM PLANT

General view of lignite burning steam plant of the State School of Science at Wahpeton, N. D. Bucket elevator discharges lignite through twin chutes to storage bunker on the inside.



Bucket elevator lifts ashes 31-feet to discharge to outside ash hopper. Trucks can be loaded by gravity discharge. 57-foot high bucket elevator at right lifts lignite to 30-ton storage bunker inside plant. Stoker hoppers are gravity fed.

S-A engineering and know-how recently combined with the North Dakota State School of Science in developing the lignite handling system shown here. Handling this tricky fuel is but one of many types of problems we have solved for others in the past. May we cooperate with you in working out plans for your fuel and ash handling operations?

Write for specific information, or technical assistance in solving your materials handling problems. No obligation.

STEPHENS-ADAMSON MFG. CO.

86 Ridgeway Avenue, Aurora, Illinois • Los Angeles, Calif. • Belleville, Ontario

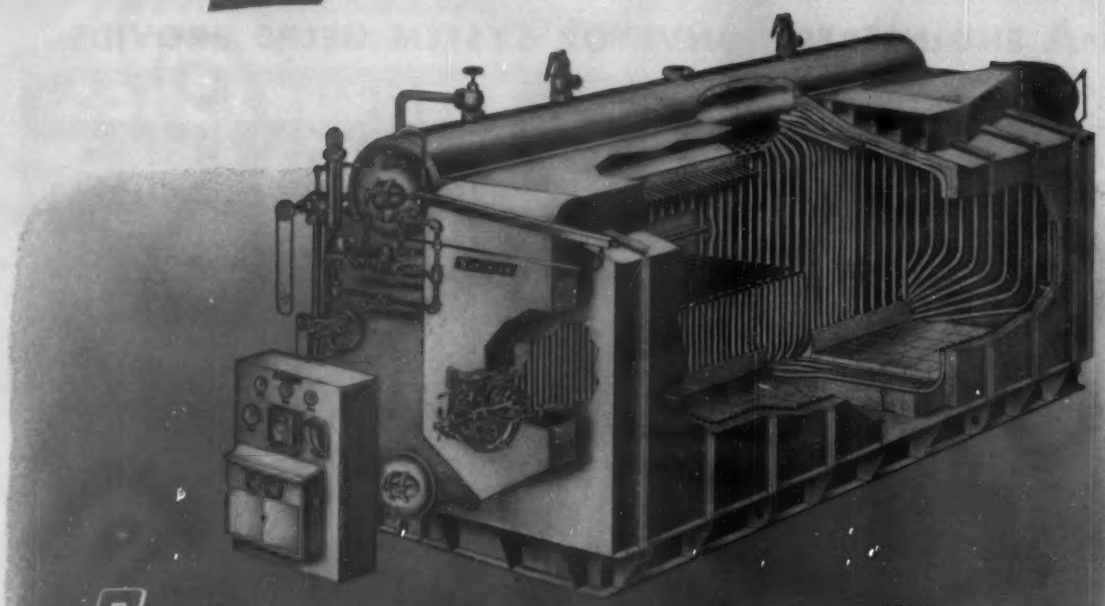
Engineering Division
Specialists in the design and manufacture of all types of bulk materials conveying systems.

Standard Products Division
A complete line of conveyor accessories, centrifugal loaders —car pullers—bin level controls

Sealmaster Division
A complete line of industrial ball bearing units available in both standard and special housings

For more data circle 556 on Post Card

With You as a Witness . . .



SUPERIOR STEAM GENERATORS
are Factory Fire Tested Before Shipment

Completely assembled Superior Steam Generators ready for shipment after factory fire test.

Unlike field erected boilers, Superior Steam Generators are completely assembled and fire tested at the factory before shipment. You get a guarantee of performance based on the results of these tests, and you may even witness the tests if you wish.

With capacities to 50,000 lbs. per hour, plus overload, in single units, much higher capacities when combined in batteries, Type D Superior Steam Generators bring the advantages of completely packaged design to capacity ranges possible heretofore only in completely or partially field erected boilers.

Write today for catalog 706D

Specialists in **PACKAGED BOILERS** . . . exclusively

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR STEAM GENERATORS

For more data circle 557 on Post Card

CATALOG LIBRARY

Standard catalogs listed monthly to help you maintain a reference library

COAL, ASH HANDLING

201 **Burning Bituminous Coal** — This 24-pp illustrated booklet is a compilation of numerous actual case histories of industrial plants and institutions which burn bituminous coal "the modern way." Stressing operating economy achieved, these case histories show problems overcome, equipment used, and savings realized. Bituminous Coal Institute.

202 **Coal Crusher** — Company's WC and WS series rolling ring coal crushers are described in Bulletin 154. Emphasizes special construction elements that mean greater coal reduction at lower operating costs. Cross section illustration shows both feeding and crushing action incorporated and tables give capacities, speeds, and dimensions. American Pulverizer Co.

203 **Why Liquid Diffusion** — What liquid diffusion can do for power plants is explained in Form B, which tells how liquid diffusion compounds work and gives four practical applications. These include dust control in coal handling, fly-ash control, coal storage pile treatment and boiler cleaning. Johnson-March Corp.

204 **Fly Ash Collection** — The successful and economical separation of fly ash from boiler flue gases is discussed in 28-pp Catalog G405. Explains need for collection equipment and gives physical charecteristics of fly ash. Describes company's Multiclone equipment as to principle of operation, performance and advantages. Western Precipitation Corp.

PUMPS, COMPRESSORS

205 **Boiler Feed Pump** — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up is the subject of 12-pp Bulletin 1525. De Laval Steam Turbine Co.

It's easy to get these free catalogs — just circle item numbers of those wanted on the postcard at right.

206 **On Vertical Pumps** — Sixteen-pp Bulletin describes and illustrates application of vertical industrial service pumps for liquid transfer from short settings in both industrial and process services. Points out advantages and describes three basic designs. Stresses versatility of the pumps due to design flexibility. Also gives general recommendations for obtaining optimum performance, and includes photos of typical installations. Peerless Pump Div., Food Machinery and Chemical Corp.

OCTOBER, 1956
Card void after
April 30, 1956

POWER ENGINEERING

Please have the manufacturers send me without obligation information or bulletins indicated by the numbers circled below.

Name..... Title.....

Company Name.....
(Must be included)

Company Address.....

City..... State.....

(If you prefer delivery at home, give home address, too)

Home Address.....

City..... State.....

| Equipment | | | | | | | Helpful Bulletins | | | | | | | Catalog Library | | | | | | |

OCTOBER, 1955
Card void after
April, 30, 1956

POWER ENGINEERING

Please have the manufacturers send me without obligation information or bulletins indicated by the numbers circled below.

Name.....Title.....

Company Name.....
(Must be included)

Company Address.....

City.....State.....

(If you prefer delivery at home, give home address, too)

Home Address.....

City.....State.....

Equipment			
1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20
21	22	23	24
25	26	27	28
29	30	31	32
33	34	35	36
37	38	39	40
41	42	43	44

Helpful Bulletins						
101	102	103	104	105	106	107
108	109	110	111	112	113	114
115	116	117	118	119	120	121
122	123	124	125	126	127	128
129	130	131	132	133	134	135
136	137	138	139	140	141	142
143	144	145	146	147	148	149
150	151	152	153	154	155	156
157	158	159	160	161	162	163
164	165	166	167	168	169	170
171	172	173	174	175	176	177

Catalog Library										
201	202	203	204	205	206	207	208	209	210	211
212	213	214	215	216	217	218	219	220	221	222
223	224	225	226	227	228	229	230	231	232	233
234	235	236	237	238	239	240	241	242	243	244
245	246	247	248	249	250	251	252	253	254	255
256	257	258	259	260	261	262	263	264	265	266
267	268	269	270	271	272	273	274	275	276	277
278	279	280	281	282	283	284	285	286	287	288
289	290	291	292	293	294	295	296	297	298	299

Advertised Products and Services

501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521
522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542
543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563
564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584
585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605

Use this space to ask for tear sheets and other information.

FIRST CLASS
PERMIT No. 353
Sec. 349 P.L.&R.
CHICAGO, ILL.

BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY—

POWER ENGINEERING
1150 South Dearborn
CHICAGO 3, ILLINOIS

207 Packaged Feed Systems — Chemical feed systems for general water treating requirements and for individual chemical processing needs are described in Bulletin LP-1254. Gives general specifications and diagrams some standard and special designs. Company's Phila-Feeder controlled capacity proportioning pump, incorporated in the systems, is described in detail. Philadelphia Pump and Machinery Co., Inc.

208 Boiler Feed Pumps — Bulletin 109, 16 pp, illustrated in color, describes centrifugal pumps for boiler feed service. Pictures construction and major parts, floating seal incorporated. Capacity data included. Pacific Pumps, Inc.

209 Balanced Opposed Compressors — Engineering data on company's balanced opposed compressors, 3000 to 10,000 hp (top range in tandem arrangement) is contained in 36-pp Bulletin L-676-B1. Presents information on operation, drives, design features, running gear, lubrication, valve action, capacity control, coolers and accessories. A chart listing approximate dimensions is included, along with photos of compressor installations. Worthington Corp.

WATER CONDITIONING

210 What's What on Ion Exchangers — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, Super Nalcolite. National Aluminate Corp.

211 Keeping Equipment Clean — Suggested policies to follow in keeping water-using equipment clean are discussed in this 6-pp folder. Mentions trouble spots that can cause failures and enforced shutdowns. Cites several examples in which special problems were solved through proper cleaning program. Hall Laboratories, Inc.

212 Steam System Treatment — This bulletin on Corsvol for prevention of corrosion explains theory of corrosion, application of organic amines to steam systems (Corsvol process) and presents case histories of use in different types of plants and industries. Corsvol is part of a complete technical service providing chemical formulae for treatment of water, steam, brine, fuel. Western Chemical Co.

213 On Cooling Tower Wood — The protection of cooling tower wood is the subject of Technical Paper 130. Explains how chemical and bacteriological attack can be controlled by acid treatment and wood preservatives to kill fungi. W. H. & L. D. Betz.

214 Chemical Treating of Feedwater — Application Engineering Data Sheet D-643 discusses use of Hydrazine in treating feedwater for high pressure boilers. Tells how precise addition of this chemical to boiler feedwater maintains residual oxygen content at zero and also prevents ammonia accumulation in the system. Milton Roy Co.

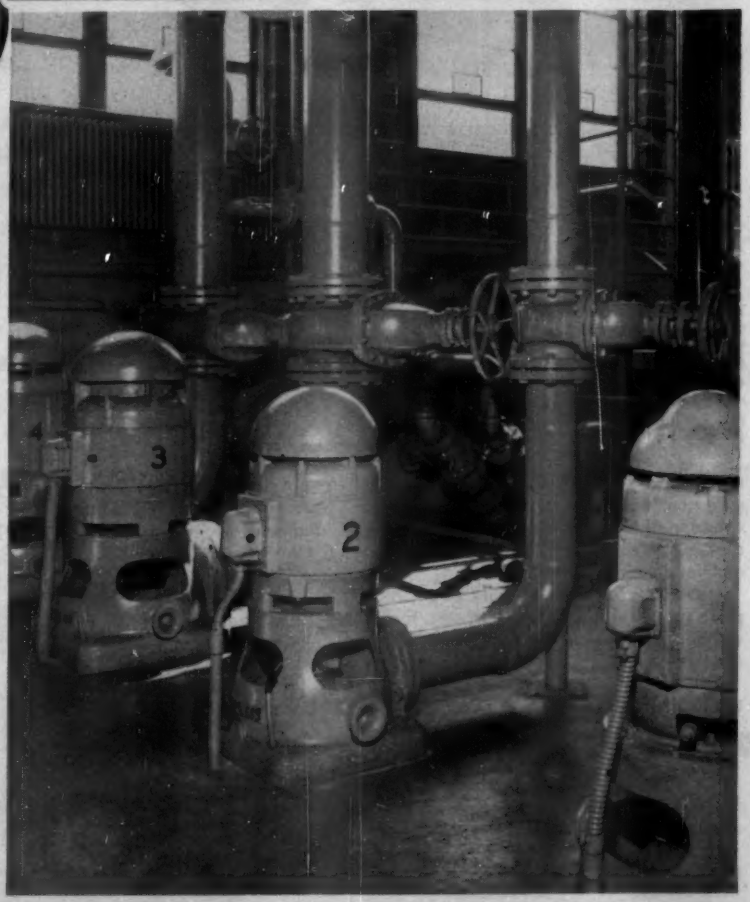
Vertical Versatility

IN PUMPING LIQUIDS FROM SHORT SETTINGS

PEERLESS PUMPS

PEERLESS INDUSTRIAL SERVICE PUMPS

3 PRODUCTION DESIGNS . . . Standard, Heavy-Duty and Special Service Types Provide Widest Flexibility in Application



Single and Multi-Stage Units Available Engineered to the Individual Application

Advantages and Features of the Peerless Vertical Industrial Service Pump

→ **SAVES ON PIPING**—Eliminates suction piping.

→ **ALWAYS PRIMED**—Once installed, always primed.

→ **SPACE SAVING**—Requires minimum floor space.

→ **ALL TYPES OF DRIVES**—Leading makes of electric hollowshaft and solid shaft motors; right angle gear drives; vertical and horizontal steam turbines.

→ **IMPROVED SUCTION**—New bell mouth suction manifold immeasurably improves water entrance conditions.

→ **HIGHEST EFFICIENCIES**—Peerless advanced vertical turbine design records highest in pump efficiencies.

→ **FLEXIBILITY**—Easiest to adapt to future system needs.

→ **COMPLETE LINE**—Peerless makes available broadest range of vertical turbine pump capacities, head conditions and horsepowers offered by any manufacturer. Capacities: 30 gpm to 40,000 gpm. Heads: up to 1000 feet. Electric drive up to 2500 hp.

NEW BULLETIN—FREE! JUST FILL OUT COUPON AND MAIL TODAY

New 16-page bulletin is profusely illustrated, describing completely all 3 Peerless types. Contains new engineering data on sump designs, etc. Write today for your copy.

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
Address inquiries to Factories at:
Los Angeles 31, Calif.; Indianapolis 8, Ind.
Offices: New York, Indianapolis, Chicago, St. Louis, Atlanta, Dallas, Plainview, and Lubbock, Texas; Fresno, Los Angeles, San Francisco, Phoenix, Albuquerque.
Distributors in Principal Cities:
Consult your Telephone Directory.

PEERLESS PUMPS fmc

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
301 West Avenue 26
Los Angeles 31, California

Please send copy of Industrial Service Pump Bulletin No. B-505

NAME_____

COMPANY_____

STREET_____

CITY_____ STATE_____

P-E

For more data circle 558 on Post Card

INSTROF

for the support of instrument tubing

BOX GIRDER—for long unsupported span lengths.

TUBE RACE—for branch run.

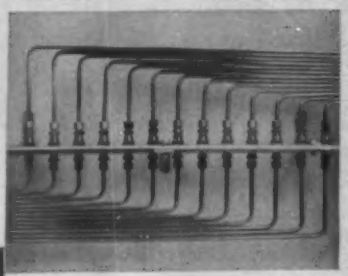
The Instrof System installed in a large South-West Coast Chemical Plant. All fittings are stock items which were rapidly assembled on the job. System is ready for placement of tubing.

Instrof is a system of prefabricated metal trough specifically designed to give continuous support and protection to instrument tubing. It is the most versatile system of its kind on the market today, and can be readily assembled at the job site in an extremely short time. Once installed, it requires no maintenance.

Instrof is available in widths of 3", 6", 9", 12", 18", and 24" with a complete range of fittings for all widths. These fittings enable the system to follow walls, change direction and elevation, and to change from one width to another—in short, to conform to any plant layout.

For further information on how the Instrof System can help solve your tubing problems, write today for the new Instrof Catalog. Ask for Bulletin P-8.

The Instrof Bulkhead Bar is a light section of channel with ¼" brass couplings mounted on 1½" center. It can be used wherever straight or angle tube terminal connections are required, such as junction boxes, panel boards, etc. It is especially adaptable to mounting on Instrof sections. The standard bar contains 40 ¼" brass couplings and is five feet long. Other sizes can be manufactured to customer's specifications.



INSTROF

INCORPORATED

4923 PENTRIDGE ST.
PHILADELPHIA 43, PA.

For more data circle 559 on Post Card

215 Feedwater Treating — Bulletin 1855, 30 pp, features manufacturer's hot process Accelerator for treatment of boiler feedwater, illustrating and explaining its operation and advantages, also optional equipment. Contains excellent discussion of necessity for treatment of makeup water, selection of proper equipment. Also covers the limitations of hot process softening. Infilco Inc.

216 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

217 For Water Wells — An acidizing service for water wells, designed to increase water yield by enlarging formation channels and by removing scale deposits from pumps and screens is described in this folder. Lists advantages of this service, and cites some case histories. Dowell Inc.

218 For Industrial Water Softening — Greensand, zeolite and resinous exchange water softeners are described in 8-pp Form S-105. Discusses features and applications of each of these basic types and illustrates some installations. Includes capacity data and general specifications. Also describes and pictures controls for water softeners, pressure filters and deionizers. Illinois Water Treatment Co.

219 Demineralizers — Valuable information on demineralization is offered power engineers in comprehensive 24-pp Bulletin WC-111. Discusses demineralization in general and its advantages and applications. Basic types of demineralizers and their special uses are charted. Resins, piping, valves and accessory equipment are treated in detail. Book also provides flow charts showing demineralization systems for chemical plants and power plants. Graver Water Conditioning Co.

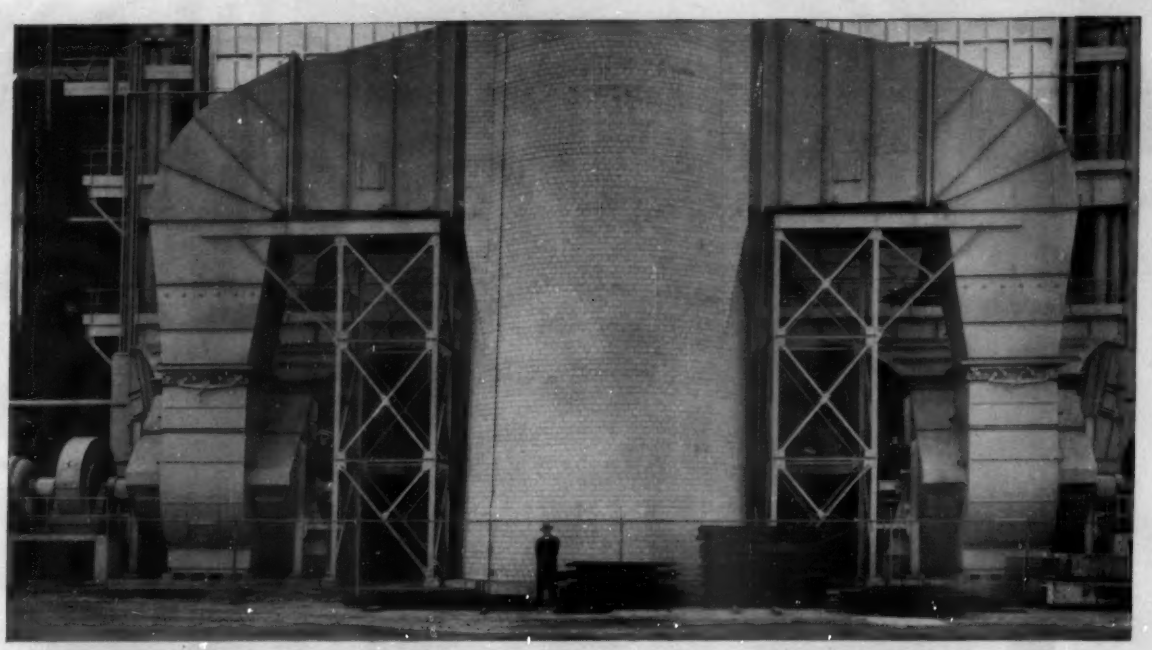
TUBING AND ACCESSORIES

220 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads. Roto Div., Elliott Co.

221 Nickel Pipe and Tubes — Bulletin T-17 is a 28-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties, ASME code requirements, recommended welding procedures. The International Nickel Co., Inc.

222 Tube Cleaners — Catalog 76-A provides 48 pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Air valves, hose, lubricators are described. Thomas C. Wilson, Inc.

223 Life Extension for Condenser Tubes — The 32-pp current edition of this booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be



SHEET and PLATE FABRICATION for POWER PLANTS

● breechings ● air & gas ducts ● stacks ● casings ● bins and hoppers
● louvers ● exhaust piping ● insulation jacketing ● control panels and desks

WHATEVER YOUR REQUIREMENTS IN SHEET AND PLATE FABRICATION...CALL ON **KIRK AND BLUM**

The fabrication of sheet steel and plate to exacting specifications has been a specialty of Kirk & Blum for more than 47 years. Exceptional experience and complete facilities up to ½" in carbon steel, stainless, aluminum, monel and other alloys.

Send prints for prompt quotation or write for your copy of the latest Kirk & Blum Sheet and Plate Fabrication catalog.

THE KIRK AND BLUM MANUFACTURING CO. 3230 FORRER STREET, CINCINNATI 9, OHIO

For more data circle 560 on Post Card

Three 125,000 #/HR STEAM GENERATORS by Vogt AT LION OIL COMPANY'S BARTON CHEMICAL PLANT

★ The new $30 million Lion Oil Company's Barton Chemical Plant at Luling, La. produces 300 tons daily of essential nitrogen fertilizer materials to boost crop yields and reduce unit production costs on the nation's farms.

PRINCIPAL DATA, EACH UNIT

125,000 pounds per hour capacity.

Fusion welded steam and water drums designed for 725 lbs. S.W.P.

Superheater delivers steam at 750°F. total temperature.

Water cooled furnace.

Burners for Gas and Oil fuel.

Vogt offers a complete line of custom built type and package unit type steam generators. Available in bent tube types and straight tube, forged steel sectional header types for solid, liquid, or gaseous fuel burned singly or in combination. Write for bulletins.

HENRY VOGT MACHINE 75th Anniversary

Henry Vogt Machine Co., Louisville, Ky.

BRANCH OFFICES:
New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va., San Francisco

For more data circle 561 on Post Card

necessary in some circumstances. Revere Copper and Brass, Inc.

BOILERS, GENERATORS

224 Packaged Boilers — This 16-pp illustrated catalog describes manufacturer's new Type VP package boiler. Following a section of background information is an outline of the principal design features of these boilers, which are shop assembled and provide steam capacities from 4000 to 30,000 lb per hour. Space requirements are shown in a table along with typical specifications. Also described is control system. Combustion Engineering, Inc.

225 Improved Steam Generator — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions for the units which range from 20 to 6000 hp. Preferred Utilities Mfg. Corp.

226 Steam Generators — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-tube boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cutaway illustration shows design details, and gas travel. Erie City Iron Works.

227 Steam Generator — This manufacturer's new Type D steam generator, a packaged unit for pressure firing with gas, oils or combination of fuels, is described in an 8-pp catalog. Gives complete data and dimensions on this water tube generator which is available in 17 sizes with capacities from 8000 to 40,000 lb of steam per hour. Fully illustrated, booklet explains economical steam production. Superior Combustion Industries Inc.

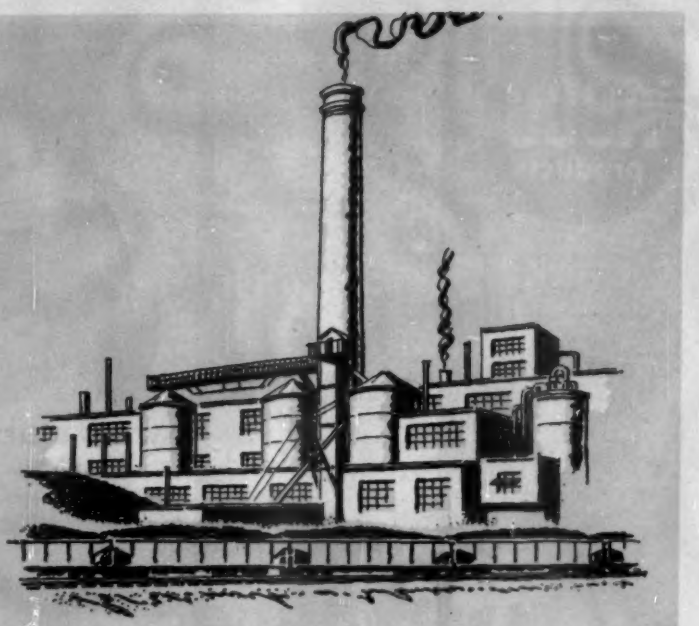
228 Automatic Boilers — This bulletin describes 17 sizes of Powermaster packaged automatic boilers from 15 through 500 hp for steam process, steam and hot water heating service. Lists such advantages as three-pass design, forced draft and automatic controls. Describes firing equipment for light and heavy oils, gas; shows various fuel firing arrangements. Orr & Sembower, Inc.

FUEL OILS, LUBRICANTS

229 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, their uses and physical properties. Standard Oil Co. (Ind.).

230 Turbine Lubrication — The special problems of turbine lubrication are discussed in 8-pp Bulletin TU-1. Tells how purifiers keep power units in service; discusses inhibited and uninhibited oils, company's process for reducing sludge formation within lubrication system. Illustrated with diagrams of typical installations. DeLaval Separator Co.

232 Bearing Lubrication — Vol. XL, No. 10 of this company's Lubrication



Southern HELPS INDUSTRY

get Greater Value for its Coal Dollars

Basic reason—Southern produces coals to fit the widely varied firing and combustion characteristics of all types of industrial equipment. They're high BTU, low ash, accurately sized, uniform quality coals—quickly and plentifully available by rail and water anywhere in the midwest. They're the logical product of Southern's *planned diversification;* 18 modern mines advantageously located for shipping economy and long term reserves—14,000,000 tons annual production; plus Southern's *precise preparation* whereby cleanness, grade and energy content are tested and controlled to strict industrial specifications. . . . Proven application, reliable quality, dependable supply, responsible service—these add up to greater value, and the economies assured by Southern.

SEND FOR THIS FREE BOOK

"Coal and its Combustion"— written by Joseph Harrington, Southern's eminent engineering counsel; noted authority on Coal; its chemistry, preparation, efficient utilization, storing and handling.

ASK SOUTHERN'S REPRESENTATIVE TO QUOTE ON YOUR COAL REQUIREMENTS

Southern Coal Company, Inc.

GENERAL OFFICE: 333 NORTH MICHIGAN AVENUE • CHICAGO 1, ILLINOIS
OFFICES IN: LOUISVILLE, MEMPHIS, NASHVILLE, ST. LOUIS
SINCLAIR COAL COMPANY, KANSAS CITY 5, MO., WESTERN REPRESENTATIVE

For more data circle 562 on Post Card

R-P&C's complete line of Cast Steel Valves and Fittings

—SIZES UP TO 24"

—PRESSURE CLASSES FROM 150 TO 2500 LBS.

• R-P&C's valve line includes a complete selection of cast steel valves and fittings. These are manufactured in all standard valve steels in a complete range of sizes, pressure classes, and styles.

• Included are gates, globes and angles, swing and lift checks, in a wide range of constructions, and all classes of flanged fittings. Pressure sealed designs for high temperatures and pressures, automatic stop and check valves, and many other special purpose valves and fittings complete the line.

• All R-P&C steel valves and fittings conform to the exacting standards of design and manufacture that users have learned to expect from R-P&C. And all are providing, in many different applications, the dependability that is the R-P&C standard.

See your R-P&C distributor or write for R-P&C's convenient catalog

FREE WALL CHART
"How to Protect Your Valves"
17" x 11" wall chart gives installation and operation pointers to protect valves, prolong life. Free on request.

ACCO

R-P&C Valve Division
AMERICAN CHAIN & CABLE

Reading, Pa., Atlanta, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

R-P&C valves

For more data circle 563 on Post Card

magazine provides an excellent 12-pp article on industrial bearing lubrication. Illustrated with photos and drawings, text covers such subjects as bearing design; bearing surfaces; bearing overhaul; aspects of lubrication, including factors involved in choice of turbine oils and diesel lubricants, and the deleterious effects of moisture; and the life expectancy of bearing lubricants. The Texas Co.

VALVES, TRAPS, PIPING AND ACCESSORIES

234 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principles of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

235 Lubricated Plug Valves — Revised Catalog PV-2, 12 pp, presents steel and semi-steel valves designed to offer quick shut-off of erosive or corrosive fluids. Explains advantages of the lubricated tapered plug design of these valves and pictures single gland, screwed gland, and bolted gland types. Also shows accessories. The William Powell Co.

236 Blow-Off Valves — Bulletin B-426, 20 pp, on blow-off valves for boiler pressures up to 400 lb wsp, contains installation recommendations, construction information on Yarway seatless and double-tightening blow-off valves. Gives full ordering data. Yarnall-Waring Co.

237 For Precise Control — Fifty-pp Catalog 17 covers manufacturer's line of disc valves and accessories, providing full selection and ordering data, materials of construction, sizes. Describes manual and automatic controls for these valves which, it is noted, are available in any metal which can be cast or welded. Minimum pressure drop, quick closure, simplicity and other advantages are discussed. R. S. Valve Div., S. Morgan Smith Co.

238 Valve Chart — Form 194, 24 pp, is a valve comparison chart, listing valve figure numbers of 15 major manufacturers and the OIC equivalent valve figure numbers. Compares variety of valves in ferrous and non-ferrous materials, describes different valve lines. The Ohio Injector Co.

239 Choosing the Right Valve — Presenting valve selection as a matter of matching the valve's service characteristics with service requirements of the job, this practical 20-pp booklet explains and illustrates basic design features of gate, globe and check valves. It tells, in non-technical language, how each of these valve types works, and where it is suited for use. Disc, stem connection, bonnet and bonnet-joint characteristics are also discussed. Crane Co.

240 Steel Gate Valves — Four types of Hancock general purpose steel gate valves for process and power piping systems are described in illustrated Bulletin 202 C, 12 pp. Material specifications, dimensions given, also service pressure ratings. Manning, Maxwell & Moore, Inc.

241 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water

column blow-down, and other types of pipe line. Everlasting Valve Co.

242 Industrial Valves — Condensed Catalog 105, 28-pp, contains data on valves for a wide variety of applications. Includes dimensions and illustrations describing non-return (stop-check) valves, globe and angle stop valves, pressure seal design, angle univalves and small size globe valves designed for chain or extension operation in vertical lines. Also included is company's Mudwonder valve for abrasive fluids. Edward Valves, Inc.

243 Steam Trap Book — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

244 Steam Trap Solutions — Bulletin F. 151, 36 pp, is a newly revised edition of this company's well known booklet, "Solving Steam Trap Problems." Organized for easy reference, this illustrated booklet provides specifications and capacities of steam and float traps, air release valves, pipe line strainers. Tells how to calculate condensation loads and select traps for unit heaters, jacketed kettles, submerged surfaces. Gives tips on installing, servicing. The V. D. Anderson Co.

245 Insulated Piping Systems — Prefabricated insulated piping units for underground or overhead systems are described and illustrated in this 24-pp booklet. Tells advantages of this insulated piping and gives specific application information on Uniline insulated units, insulated jacketed pipe units, prefabricated accessories, field connections. Shows features that make these units easier to install and pictures some applications. Specifications and trenching data are included, also conduit sizing chart. Booklet also describes cast iron insulated pipe units, and Utilidor conduits. Ric-wiL, Inc.

247 Improved Pipe Hanger — Twelve-pp Bulletin 153 describes company's Counterpoise pipe hanger for high temperature piping systems in steam generating stations, refineries and chemical plants. Tells how it offers efficient load supporting effort of constant value throughout entire range of travel as pipe expands or contracts. National Valve & Mfg. Co.

248 Stainless Steel Pipe Fittings — Bulletin S-3-55 describes company's 150 lb stainless steel pipe fittings for corrosive, high and low temperature service, including 90 deg elbows, tees, 45 deg elbows, crosses, couplings, reducers, pipe caps, unions, plugs and bushings. Presents dimensional specifications in sizes ⅛ to 2 in. in both screw end and socket welding types. Applications in chemical plants, refrigeration service, food and other process piping given. Watson-Stillman Fittings Div., H. K. Porter Co., Inc.

ELECTRICAL EQUIPMENT

249 Motor-Generator Reference Book — Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither textbook nor ordering catalog, this book provides a brief

Choose WESTERN
for Chemical Treatment of Water, Steam and Fuel

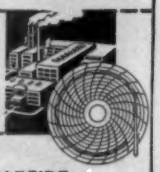
Look them over! Check your needs! Every Western product for treatment of water, steam or fuel is proved in use, technically formulated for each individual problem.

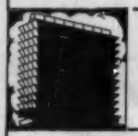
1 Steam + CORAVOL = Protection (FROM CORROSION)

CORAVOL circulating throughout your steam system protects it from corrosive attack; cleans out rust deposits; increases heating and operating efficiency; reduces maintenance and labor costs. CORAVOL is the *original amine process* developed by Western Chemical Company.

2 WESTERN BOILER FEED WATER TREATMENT

Special formulas for each individual boiler water and operating condition to eliminate scale, corrosion and foaming.





3 COOLING WATER TREATMENT AND ALGAECIDE

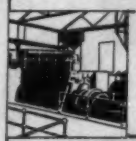
Prevents scale deposit, corrosion, and algae growth in every type of cooling and condenser water system.

4 BRINE AND SWEET WATER TREATMENT

Prevents corrosion and protects tanks and equipment in refrigerating brine and sweet water systems.

5 WESTO HOT WATER TREATMENT

Stops corrosion and scaling in hot water supply tanks and lines, maintaining service without impairing potability.



6 WESTERN LIGHTNING TREATMENT

Disintegrates and removes scale quickly from water jackets, cylinder heads, condensers, compressors, lines, coils, pumps.

7 WESTERN ALUMINA NO. 45

Provides efficient coagulation in raw water ice manufacture, lime and soda softeners, water supply clarification.

8 WESTERN SOOT REMOVER

Removes and prevents soot deposits in combustion areas, thus increasing fuel economy and boiler capacity.

9 WESTERN FUEL OIL SLUDGE DISPERSANT

Eliminates sludge and moisture in fuel oil, effecting clean tanks, lines, and burners, and improved combustion.

Chemical Treatment for Water Steam and Fuel

WESTERN CHEMICAL COMPANY

717 Washington Street
Kansas City 5, Missouri

MAIL THIS COUPON TODAY

Western Chemical Company
717 Washington Street
Kansas City 5, Missouri

Send me full information about products checked.

1 2 3 4 5 6 7 8 9

Name

Firm

Address

City Zone State

For more data circle 564 on Post Card

BIDDLE *Instrument News*

BIDDLE MOTOR ROTATION TESTER ELIMINATES GUESSWORK AND DANGER

SAVES TIME in Electric Motor Hook-Ups

This tester eliminates the need for temporary connections which can be time consuming, costly, and quite hazardous, particularly where many large high-voltage motors are involved. With this instrument you can very easily determine direction of rotation for any size 1, 2 or 3-phase motor, and make your first connections *permanent* ones with safe assurance they are correct. You can use it also to test circuits, check phase sequence and identify windings of multi-speed or multi-voltage motors.

Write for BULLETIN 80-PE.

MEGGER® ELECTRICAL INSULATION TESTERS

Hand—Rectifier—or Combination Operation—

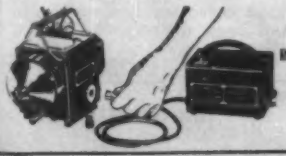
Ratings up to 2000 Megohms and 1000 Volts D-C

HAND CRANK MEG TYPE

of Megger Insulation Tester is a reliable field instrument, light, sturdy, with a constant-voltage type generator—no dependence on batteries or other current supply. By far the most popular instrument among electrical plant maintenance men. Easy to use—easy to read—and rugged in constant services.

RECTIFIER OPERATED Meg Type of Megger Insulation Tester simply plugs into a convenient outlet. Portable or flush bench-mounted. A dependable production or inspection instrument. Quick, easy readings speed up otherwise costly tests.

DUAL-OPERATED MEG TYPE of Megger Insulation Tester may be operated by hand or rectifier. Excellent solution for those requiring a versatile instrument for field and bench use.



Write for BULLETINS 21-45 PE 21-46 PE

IF YOU MEASURE SPEED • • • YOUR BEST BET IS BIDDLE

Average Measuring RPM or FPM Jagabi® Speed Indicator

Dr. Horn Tachometer

Jagabi® Tachometer

Instantaneous Speeds or Variations in Speeds. Write for BULLETIN 35-PE

B-525

Frahm® Resonant Reed Tachometer Quick Accurate Readings with Safety BULLETIN 31-PE

JAMES G. BIDDLE CO.

• ELECTRICAL TESTING INSTRUMENTS
• SPEED MEASURING INSTRUMENTS
• LABORATORY & SCIENTIFIC EQUIPMENT

1316 ARCH STREET
PHILADELPHIA 7, PA.

outline of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, information on methods of speed control. Allis-Chalmers Mfg. Co.

250 Motor Buying Guide — Bulletin GEC-1026, 28-pp, features company's standard a-c fractional and integral horsepower motors in most general use. Included are general- and definite-purpose fhp motors, and fhp gear motors. A section on selection of integral horsepower motors covers horsepower requirements, enclosures, starting current limitations, speeds, motor types, and selection of fuses and circuit breakers. Descriptions and specifications include single-phase, polyphase, totally enclosed fan cooled, and gear-type integral horsepower motors. Ratings, book prices included. General Electric Co.

251 Insulation Temperature-Resistance — Technical Publication 21T4, 16 pp, is an article on temperature-resistance characteristics of electrical insulation. Complete with tables and graphs, gives general information on variations in temperature characteristics, composite nature of electrical insulation, and practicability of temperature compensation. Other chapters deal with determining insulation constants for temperature correction factors, and a practical method of obtaining insulation temperature. James G. Biddle Co.

252 The Answers on Wiring — "20 Questions and 20 Answers on Safety m.i. wiring" describes and illustrates characteristics and advantages of this new wiring system. A complete table of types, sizes, weights and lengths, as well as a partial list of users included. General Cable Corp.

253 High-Power Batteries — Bulletin CP-538/55 covers company's line of Hi-Power batteries for use in the control, switchgear, emergency lighting and auxiliary power fields. Includes data on battery ratings and capacities, details of design and construction, dimensions, weights and types of containers. C & D Batteries, Inc.

254 High-Capacity Fuses — Form HCS, 6 pp, describes fuses of unlimited interrupting capacity on voltages to 600, designed to afford protection for loads of

THE LUMMUS COMPANY

Engineers and Constructors

385 Madison Avenue, New York, N. Y.

Chicago — Houston — London — Paris — The Hague — Montreal — Caracas — Bombay

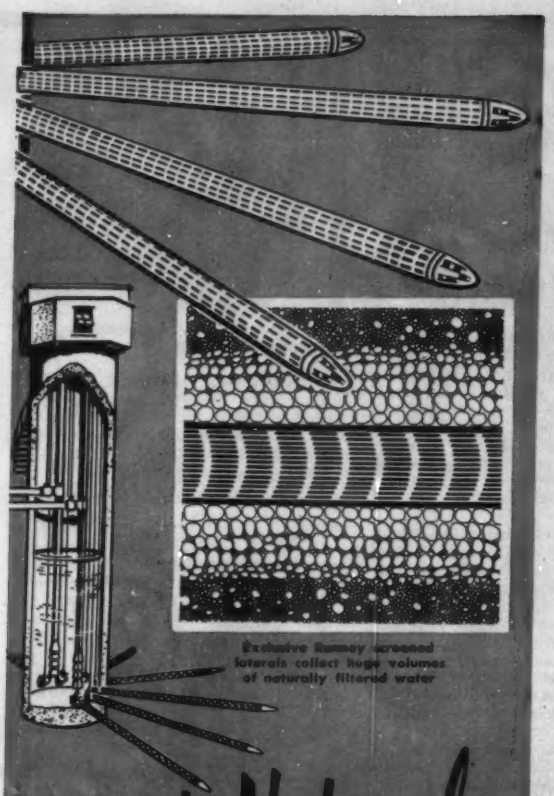
J. E. SIRRINE COMPANY

Engineers

Design and Supervision of Steam and Hydro-electric Power Plants, Industrial Plants, Mechanical and Operating Surveys, Appraisals • Plans • Reports

Greenville, South Carolina

For more data circle 565 on Post Card



Exclusive Ranney screened laterals collect huge volumes of naturally filtered water

The Ranney Method Assures a Pure, Sanitary Water Supply

Natural Filtration

The RANNEY METHOD, by Natural Filtration, produces water of better chemical quality than ground water . . . as proven by the many RANNEY installations now in operation. Each delivers millions of gallons per year of clear, non-turbid water at lowest cost. The RANNEY method reduces, or eliminates entirely, costly filter plants. If you need an efficient, economical water supply...

RANNEY METHOD

Water Supplies Inc.

Water Supply Engineers and Contractors

841 Alton Columbus 19, Ohio

TF-4

Associate:
Ranney Method Western Corp.

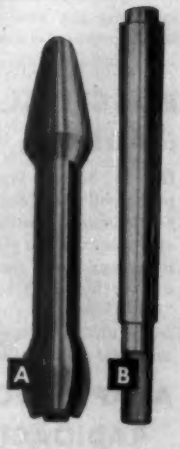
For more data circle 566 on Post Card

Wilson Tube Cutter

CUTS COSTS!

The Wilson Tube Cutter costs two to eight times less than competitive tools. You also get a tube cutter with eight exclusive features:

(1) It has fewer working parts. (2) It can cut non-ferrous tubes in under four seconds. (3) You can chuck it into your own air or electric drill. (4) It has a replaceable spacer collar to adjust for tube thickness. (5) The cutter bit retracts after withdrawal of the cutter. (6) You have a choice of round or taper shank in smaller sizes. (7) To operate, you insert the cutter in the tube, switch on the power, and press forward. (8) It takes the punishment of constant use.



A Tube Pilot guides tubes through baffles and far sheet when retubing.

B Tube Knockout tool for manual or mechanical use.

It makes good sense to buy the Wilson Tube Cutter and accessories. For some more suggestions that will cut your tube maintenance costs, write for Wilson comprehensive Tube Expander Catalog. For tube cleaners, send for Wilson Catalog 77.

Don't Forget!

For cleaner cleaning WILSON TUBE CLEANERS

For easy, accurate tube rolling WILSON TUBE EXPANDERS

Representatives in principal cities

THOMAS C. WILSON, INC. • 21-11 44th Ave., Long Island City 1, N.Y.

Cable address: "Tubeclean", New York

TW 851

WILSON

TUBE CLEANERS • TUBE EXPANDERS

For more data circle 567 on Post Card

ILLCO-WAY
ionXchange

PURIFIES WATER BY REMOVING DISSOLVED SOLIDS

The most *reliable* method of purifying water containing dissolved solids such as calcium carbonate, magnesium sulphate, sodium chloride, silica, or many other common contaminants, is ILLCO-WAY ionXchange (also known as de-ionization). Many adaptations of the basic methods are available including the new mixed-bed de-ionizers which produce water described by one user as of "fantastic purity"

PRACTICAL EQUIPMENT MADE BY "ILLCO-WAY"

Illinois Water Treatment Company has pioneered in the design and manufacture of *practical equipment* for ionXchange processes ever since the first year that the de-ionization idea came out of the laboratories. A wealth of experience has been accumulated so that "ILLCO-WAY" is today recognized as the *leader* in the development of *commercially successful installations.*

ADAPTED FOR PURIFYING RADIOACTIVE WASTES

With the rapid expansion of the field of nuclear science, various needs have developed for ionXchange, particularly in the purification of wastes contaminated by radioactivity. ILLCO-WAY equipment has been designed and built for this and other purposes in several plants employing atomic energy. *For further information on the uses of ILLCO-WAY ionXchange, write . . .*

ILLINOIS WATER TREATMENT CO.
ionXchange
ILLCO-WAY
840 CEDAR ST.
ROCKFORD,
ILLINOIS
NEW YORK OFFICE: 141 E. 44TH ST., NEW YORK 17, N. Y.
CANADIAN DIST. PUMPS & SOFTENERS, LTD. LONDON, ONT.

For more data circle 568 on Post Card

600 to 5000 amp. Includes test data, charts on opening time, current limiting effect. Bussmann Mfg. Co.

INSTRUMENTS AND CONTROLS

255 Metering and Control Equipment — Sixteen-pp Bulletin 18 is a comprehensive catalog offering information on company's meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate equipment. Bailey Meter Co.

256 Boiler Feed Control — Bulletin 1003, a 12-pp catalog on boiler feed regulators, is illustrated with large application photos and detailed schematic drawings and charts. Relay and direct operation are covered. Case studies of representative boiler loads are presented to show stability of the Flowmatics in controlling feedwater automatically. Copes-Vulcan Div., Continental Foundry & Machine Co.

257 Instruments, Controls — Condensed Catalog 1537 offers brief application information on manufacturer's line of instruments. Fully illustrated, covers draft and pressure instruments, flow meters, liquid levels and pressure gages, CO_2 meters, pneumatic transmitters, positioning operators, temperature instruments, boiler feedwater controls, others. Includes references to detailed literature on each type of equipment. Republic Flow Meters Co.

258 Electronic Flow Meters — Publication 55-1074-222, 12-pp, describes company's line of electronic flow meters for measurement of differential pressures, liquid level, fluid, gas, air or steam flow, temperatures and pressures. Points out advantages, describes mercury-less transmitters, transmission system, receiver, integrator, other features. The Hays Corp.

259 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

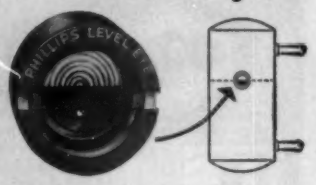
260 Ideas on Push-Pull Controls — Included in this "Idea File" are answers to a power engineer's questions on the use of push-pull controls. A general information booklet discusses remote control applications, explains construction and operation of company's Tru-Lay controls. Separate bulletins are devoted to standard assemblies, bracket-type head controls, micro controls and hand-operated controls. Automotive and Aircraft Div., American Chain & Cable Co., Inc.

OTHER EQUIPMENT

261 Steam Accumulator—How the steam supply and demand can be balanced by means of company's steam accumulator is told in Bulletin RA-52-8. Stresses reduced boiler capacity required and increased boiler efficiency afforded by use of the accumulator, other advantages. Discusses operating principle, tells how to figure capacity. Foster Wheeler Corp.

262 Refractory Notes — Included in Vol. XV of this company's Thermogram is an illustrated article on a method for degreasing hot topping costs in steel mills with minimum capital expenditure. An-

PHILLIPS
Level Eye



lets you "see" level of liquids in pressure systems

★ Low cost, simple to install
★ for temperatures from —50° to 250° F.
★ rupture strength 7500 psi
★ for use with water, oil and all refrigerants
★ Lens won't frost over
★ Available on column or for welding into your equipment
★ Standard on Phillips Float Controls

WRITE FOR "LEVEL EYE" BULLETIN

H. A. PHILLIPS & CO.
Designers and Engineers
Refrigeration
Control Systems
3255 W. Carroll Ave.
Chicago 24, Illinois

PHILLIPS

For more data circle 569 on Post Card

CONSULT US FOR:
CHIMNEYS
FURNACE WORK
BOILER SETTINGS

AMERICAN CHIMNEY CORP.
143 Fourth Ave., New York 3, N. Y.
BRANCHES: CHICAGO
BOSTON • PHILADELPHIA • CLEVELAND
DETROIT • RICHMOND, VA. • CINCINNATI, OHIO

For more data circle 570 on Post Card

other story tells how bonded brick assemblies cut installation time in a coke plant. Refractory & Insulation Corp.

264 Tubing Support System — Twelve-pp Bulletin 254 presents a system for permanent and continuous support of instrument tubing. All items and fittings are illustrated by photo or dimensional drawing. Details of actual installations show some of the methods by which this system can be quickly and economically erected at the job site. Instrof Inc.

265 Automatic Burner — Bulletin 420 contains approximately 30 pp of engineering data on a new burner unit for gas, oil or combination firing and sized for capacities to 42,000 lb of steam per hour. Separate sections of this looseleaf manual are devoted to photos and discussion of special features of the burner, general specifications, parts list, wiring and piping diagrams, explanation of operating sequence, and performance data. Available to qualified power engineers, please state your job title when requesting this bulletin. Peabody Engineering Corp.

266 Sheet and Plate Fabrication — Illustrated in 40-pp Bulletin F-3 are products of this manufacturer, and equipment used to produce special sheet steel and alloy parts. Shows control panels, switch gear housings, cubicles and other electrical enclosures, boiler air ducts, smoke breechings, tanks. The Kirk & Blum Mfg. Co.

267 Steam Condensers — Some recent additions to this company's power plant condenser installations are pictured and described briefly in this 24-pp booklet. Also included are an engineering section on condenser design factors, and sections devoted to air removal equipment, to steam condenser specialties, and to maintenance services available. Condenser Service & Engineering Co., Inc.

268 Data on Insulations — Insulation solutions for a wide range of temperature problems are charted in this folder. Provides brief descriptive information and tells forms available for high temperature applications, for intermediate temperature use, for hot and cold water and low pressure steam, for ice water and frigid temperatures. Mundet Cork Corp.

269 Refrigerator Condensers— Bulletin RC-2, 38 pp, utilizes drawings, tables and engineering data to show how to select proper type from company's line of ammonia and Freon condensers for refrigeration services. Illustrates horizontal multipass shell and tube types; vertical singlepass shell and tube types. Gives pipe sizes for ammonia and Freon lines. Henry Vogt Machine Co.

270 Oil and Gas Burners — Bulletin OB-53, 28 pp, gives principles of selection and application of oil or gas burners, or a combination of both for standard and wide capacity range operation, together with air registers and fuel oil heating and pumping sets. Conversion table shows approximate relationships between quantity of oil burned, boiler capacity and air required for combustion. The Engineer Co.

271 Belt Conveyor Carriers — Carriers designed for rugged jobs, exposure to dust and long service are the subject of illustrated Bulletin 453. Shows how their spun end rolls and welded steel frame contribute to extra strength and better balance. Stephens-Adamson Mfg. Co.

272 Preheating Combustion Air — This well-illustrated 36-pp booklet explains fuel savings and increased performance made possible by using waste heat in flue gases to preheat incoming combustion air. Also covers increased boiler output, ability to use lower grade fuels, other advantages afforded. Booklet contrasts regenerative with recuperative preheaters; explains operating principle and structural details of the Ljungstrom air preheater. Applications for other than power boilers are also covered. Air Preheater Corp.

273 Dust Collection—Aerodyne dust collectors in chemical processing and other industries are discussed in 8-pp Bulletin 171. Explains theory and design of collector system, includes drawings of the various types covered. The Green Fuel Economizer Co., Inc.

275 Turbine Speed Control—Thirty-pp wire-bound Bulletin H-21 is titled, "Fundamentals of Turbine Speed Control." It is an elaborately illustrated, educational booklet intended to clarify the operation of common types of automatic speed control for steam turbines. An introductory section covers general fundamentals of automatic control systems, and includes a key to control terminology. Simplified diagrams show operating principles of actual control systems. Elliott Co.

276 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing specific recommendations for many applications. Packing Div., Raybestos-Manhattan, Inc.

Sign Your

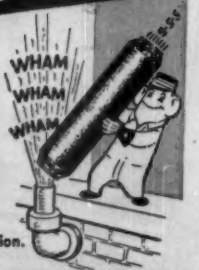
DECLARATION OF INDEPENDENCE

☆

Buy U. S. Savings Bonds!

STOP THAT NOISE!

Tame your roaring ~~lions~~ lines with
BURGESS-MANNING SNUBBERS



They are individually designed, on thoroughly proved principles, to effectively correct any intake or exhaust noise caused by the flow of air, steam, or other gases. Stop that noise — profit through better neighbor and employee relations — eliminate costly oral errors — avoid compensation claims.

Tell us your noise problem and let us recommend—no obligation.

BMM Sound Engineering

BURGESS-MANNING COMPANY
767 East Park Avenue, Libertyville, Illinois
Dallas, Texas

For more data circle 571 on Post Card

For more data circle 572 on Post Card

The Peabody PK-54 Burner

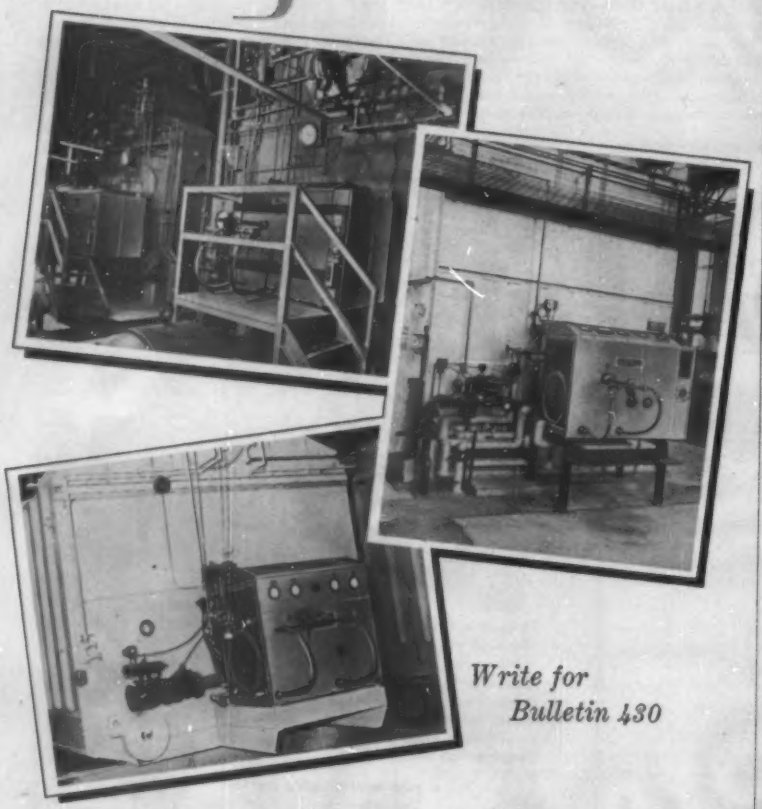
Wide Range Acceptance —

The completely integrated compact design offered by Peabody in the PK-54 Burner is based on years of experience with automatic burners. The PK-54, a modern, efficient, and improved version of the original PK Burner, has gained universal acceptance with users throughout the United States, Mexico, South America and Europe.

Safety Record —

Over 200 units now in operation are turning in enviable safety and performance records . . . *records that cannot be equaled!*

Positive proof that careful planning, design and engineering based on experience pays off for the user.



Write for Bulletin 430

PEABODY ENGINEERING CORPORATION

580 FIFTH AVENUE, NEW YORK 36, N. Y.

OFFICES IN PRINCIPAL CITIES

PEABODY LIMITED • LONDON, S.W. 1, ENGLAND

9-165

For more data circle 573 on Post Card

EQUIPMENT NEWS

Continued from page 52

31—IMPROVED SEPARATOR for compressed air

Through its arrangement of cleaning elements, the Textite Separator is designed to remove unwanted by-products of compressed air without the aid of moving parts or filter elements which must be replaced. It is explained that only the air stream moves throughout the unit where centrifugal action, jetting, sudden expansion, capillary attraction and scrubbing is brought into play to remove contaminants . . . water, oil, direct, scale, cinders. Chicago Mfg. and Distributing Co.

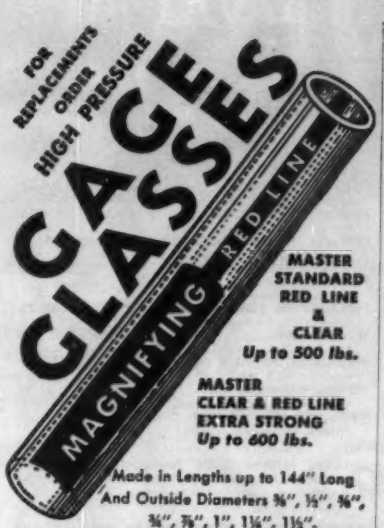
32—HEAT EXCHANGER gives close control of temperature

Designed to provide water saving in industrial cooling and give close control of temperature (within 2 F) the Panel Casing Aero Heat Exchanger cools by evaporation and controls temperature by modulating use of outdoor air. Fluid to be cooled flows through two parallel mounted coil sections, both kept drenched with a water spray. Part of this water evaporates, the balance is recirculated. Air enters through dampered intakes about the coils, travels downward through the sprays and enters a central plenum, at which point entrained moisture is eliminated. Air then moves upward and a propeller fan ejects it into the atmosphere.

Fluid in the cooling coils is cooled to a point close to the atmospheric wet bulb temperature. About 1000 Btu are transferred, through the wet coil surface to the air stream, for every pound of water evaporated, says company, and action of the air recirculation system holds temperature constant. Cooling capacity varies directly with heat input load. If heat is required, instead of cooling, it is provided with steam or electricity by a heater in the spray water tank. It is pointed out that much expense is avoided with this apparatus because it is designed to be assembled on the installation site. Since the casing is shipped as flat panels, the ratio of space to weight and freight costs are lower. This heat exchanger may be installed anywhere — usual location is outdoors, on the ground or on a roof. Four sizes afford capacities from 7,000,000 to 18,000,000 Btu/hr under standard conditions. Niagara Blower Co.

33—PUSH BUTTON ENCLOSURES are oil tight

These oil tight push button enclosures are fabricated from 14-gage steel in sizes for 1, 2, 3, 4, 6, 9, 12, 16, and 25 control units. Reported to cost less than many conventional cast aluminum push button boxes, enclosures are of all welded construction. Cover, with a sponge Neoprene gasket is fastened to box by four nickel plated captivated screws which thread into closed tapped holes located in box flange. It has a hinge arrangement to permit ready removal from box or swinging open for wiring of cover mounted control units.



Made in Lengths up to 144" Long
And Outside Diameters ⅜", ½", ⅝", ¾", ⅞", 1", 1¼", 1½".

High Pressure Composition
ERNST RUBBER GASKETS
All sizes to fit your gages and valves

FIG. 21—Lip Mold

FIG. 22—Standard

ERNST WATER COLUMN & GAGE CO.
Send for Catalog LIVINGSTON, N. J.

For more data circle 574 on Post Card

CLASSIFIED ADVERTISING

WANTED

Electrical engineering draftsman capable of general plant layout work and design for automatic control in connection with plant mechanization. Give experience and salary range with application. Location South. Box 1702, POWER ENGINEERING, 110 S. Dearborn St., Chicago 3, Ill.

FOR SALE

4—DETROIT ROTOSTOKERS

Practically new, used 1½ years, power dump grates. Complete set of spare parts for stokers and grates, could be used in quads, tripls, double or single, capacity 60,000 lbs. per hour.

MICHIGAN CHEMICAL CORPORATION
St. Louis, Michigan

Push button openings are located on 2¼ in. centers and are shaped to accommodate standard makes of control unit while retaining an oiltight seal. Enclosure has two external mounting feet, may be used in any position, and conduit connections may be of any desired size and at any location. Hoffman Engineering Corp.

Reader Service Cards on pages 117–118 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

34—ASBESTOS SHEET PACKING available in three thicknesses

No. 90 Sheet Packing is announced as suitable for handling steam, hot and cold water, brine, air and oil up to 300 psi and 500 F. Its average tensile strength of cross-laminated material is 4500 psi, says manufacturer, and for homogenous packing, 3000 psi; it analyzes 70 per cent ash with a 2 per cent water absorption. Gray black in color, this packing comes in ⅛, 1/16- and 1/32-in. thicknesses. Sheet sizes are 48-by-48 in. for both cross-laminated and homogenous types, and 48-by-72 in. and 48-by-144 in. for the homogenous material. Thermoid Co.

35—SILICON RECTIFIERS with high power ratings

Silicon rectifiers capable of handling up to several kilowatts of power are announced by this company. The new diodes have a typical forward voltage drop of only 0.7 v, reports state, at a current of 8 amp and at a cell temperature of 190 C. When mounted in a finned case one inch high and 1½ in. in diam, this unit is said to have a rating of 15 amp at 200 v peak inverse. This is with natural convection cooling in a 65 C ambient. At present, it is available in 50, 100, 150 and 200 v ratings, having a forward current rating of 8 amp with natural convection cooling at 25 C. Higher current ratings up to 40 amp can be achieved with forced cooling. Westinghouse Electric Corp.

Nothing show-off about continuous blow-off

No big blast . . . no noise . . . no clouds of steam. No wasted heat units down the drain either. Just steady removal of foreign solids to keep the boiler always in balance. It's not a flashy performer, except in the cost department. Hardly anything else in the boiler room can pay its own way so quickly. Find out why; write for catalog on "Continuous Blow-off" to *The Madden Corp., 1543 W. Morse Ave., Chicago 26, Ill.*

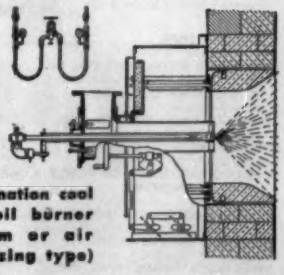
For more data circle 575 on Post Card

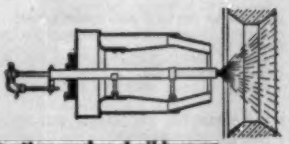
Enco
OIL BURNERS
have these
7 ADVANTAGES
in pulverized coal fired boilers . . .

They may be installed in practically all types of pulverized coal burners, with these seven important advantages:

- They warm up cold furnaces
- They ignite pulverized coal—safely
- They assure continuous operation in case coal system fails
- They provide efficient and safe operation on bank and at low loads
- They respond almost instantly to sudden load changes
- They permit operation with oil or coal—whichever is available and lowest in cost per BTU.
- All capacities of steam, air or mechanical-atomizing types are interchangeable

The foregoing are only a few of the reasons why Enco oil-burners have been bought by a long list of leading industrial firms. Details of how Enco oil-burners can be adapted to your present pulverized coal burners will be gladly supplied—without obligation. Write The Engineer Company, 75 West St., New York, N. Y.


Combination coal and oil burner (Steam or air atomizing type)


Combination coal and oil burner (Mechanical atomizing type)

Enco Burners

For more data circle 576 on Post Card

ADVERTISERS' INDEX

AIR PREHEATER CORP., INC. ..... *
Agency—G. M. Basford Company
AIRETOOL MFG. CO. ..... *
Agency—Harry M. Miller, Inc.
ALLIS-CHALMERS MFG. CO. 31, 33–36, 51
Agency—Campton Advertising, Inc.
ALLIS-CHALMERS MFG. CO. (TRACTOR DIV.) ... *
Agency—Bert S. Gittins Advertising
AMERICAN BLOWER CORP. ..... *
Agency—Brooke, Smith, French & Dorrance, Inc.
AMERICAN CHAIN & CABLE CO., INC. 124
Agency—Reincke, Meyer & Finn, Inc.
AMERICAN CHIMNEY CORP. 128

AMERICAN ENGINEERING CO. 108
Agency—Beatty and Oliver, Inc.
AMERICAN PULVERIZER CO. 114
Agency—Batz-Hodgson-Neuwoehner
AMERICAN WATER SOFTENER CO., INC. 110
Agency—Willard G. Myers Advertising Agency
V. D. ANDERSON CO. 52
Agency—Will, Inc.
ARMSTRONG MACHINE WORKS 2
Agency—Russell T. Gray, Inc.

BABBITT STEAM SPECIALTY CO. ..... *
Agency—George T. Metcalf Co.
BABCOCK & WILCOX CO., THE 134
Agency—O. S. Tyson and Co., Inc.
BAILEY METER COMPANY 7
Agency—Fuller & Smith & Ross, Inc.
BALDWIN-HILL CO. ..... *
Agency—Eldridge, Inc.
BALTIMORE & OHIO RR. ..... *
Agency—Richard A. Foley, Inc.
BECKMAN, ARNOLD O., INC. ..... *
Agency—Dozier Eastman & Co.
BELMONT PACKING & RUBBER CO., THE ..... *
Agency—Roa, Fuller & Co., Inc.
BETZ, W. H. & L. D. 101
Agency—The Michener Co.
BIDDLE CO., JAMES G. 126
Agency—The Roland G. E. Ullman Organization, Inc.
BIRD-ARCHER CO., THE ..... *
Agency—The Roland G. E. Ullman Org.
BITUMINOUS COAL INSTITUTE 57
Agency—Vansant, Dugdale & Co., Inc.
BOILER ENGINEERING & SUPPLY CO. ..... *
Agency—John B. Ferguson Jr.
BOWSER, INC. ..... *
Agency—Willis S. Martin Co.
WM. BROS BOILER & MFG. CO. ..... *
Agency—The Alfred Colle Co.
BURGESS-MANNING CO. 129
Agency—Merchandising Advertisers, Inc.
BUSSMANN MFG. CO. 16–17

BYRON-JACKSON DIV. ..... *

BORG-WARNER CORP. ..... *
Agency—Ramsey, Brown & Co.

C & D BATTERIES 50
Agency—John T. Hall & Co.
CAMBRIDGE INSTRUMENT CO., INC. ..... *
Agency—E. M. Freystadt Associates, Inc.
J. A. CAMPBELL CO. ..... *
Agency—The McCarty Co.
CHAPMAN VALVE MFG. CO., THE .. Inside Back Cover
Agency—Sutherland-Abbott
CHESAPEAKE & OHIO RAILROAD 20
Agency—Robert Conahay, Inc.
CHICAGO EXPOSITION OF POWER & MECHANICAL ENGINEERING 37
Agency—O. S. Tyson & Co., Inc.
CLEAVER BROOKS CO. (BOILER DIV.) ..... *
Agency—Klau-Van Pietersom-Dunlap, Inc.
COCHRANE CORPORATION ..... *
Agency—Hennig & Co., Inc.
COMBUSTION ENGINEERING, INC. 14–15
Agency—G. M. Basford Company
CONDENSER SERVICE AND ENGINEERING 32
Agency—Joseph S. Vogel & Co.
CRANE CO. 43
Agency—The Buchen Company
CRANE PACKING CO. ..... *
Agency—Symonds, MacKenzie & Co., Inc.

DART UNION CO. ..... *
Agency—Sutherland-Abbott
DAVIS ENGINEERING CORPORATION ..... *
Agency—Thomas & Delehanty, Inc.
DEARBORN, CHEMICAL CO. 47
Agency—The Buchen Co.
DE LAVAL SEPARATOR CO., THE 3
Agency—Donahue & Co., Inc.
DE LAVAL STEAM TURBINE CO. 133
Agency—Michel-Cather, Inc.

DETROIT STOKER COMPANY ..... *
Agency—Witte & Burden
DOWELL INCORPORATED 27
Agency—MacManus, John & Adams, Inc.

EDWARD VALVES, INC. ..... *
Agency—Marsteller, Rickard, Gebhardt & Reed, Inc.
ELLIOTT CO. ..... *
Agency—Peterson & Kempner, Inc.
ELLISON DRAFT GAGE CO. ..... *
Agency—Tri-State Advertising Co., Inc.
ENGINEER CO., THE 131
Agency—Michel-Cather, Inc.
ERIE CITY IRON WORKS 41
Agency—Davies and McKinney
ERNST WATER COLUMN & GAGE CO. 131
Agency—Lasky Co.
EVERLASTING VALVE CO. ..... *
Agency—Michel-Cather, Inc.

FOSTER WHEELER CORP. 10–11
Agency—Marsteller, Rickard, Gebhardt & Reed, Inc.

GARLOCK PACKING CO., THE ..... *
Agency—Hutchins Advertising Company, Inc.
GENERAL CABLE CORP. 49
Agency—Hicks & Greist, Inc.
GENERAL ELECTRIC CO. ..... *
Agency—G. M. Basford Co.
GOODALL RUBBER CO. ..... *
Agency—George C. Taylor Advertising
GRAVER WATER CONDITIONING CO. ..... *
Agency—Trade Method Advertising
GREEN FUEL ECONOMIZER CO. 104
Agency—Sanger-Funnell, Inc.
GUSTIN-BACON MFG. CO. ..... *
Agency—Valentine-Radford Advertising

HAGAN CORPORATION ..... *
Agency—Ketchum, MacLeod & Grove, Inc.
HALL LABORATORIES, INC. 53
Agency—Ketchum, MacLeod & Grove, Inc.
HAYS CORPORATION, THE 45
Agency—Proebsting, Taylor, Inc.
HENSLEY COMPANY ..... *
Agency—Keck Advertising Agency
HILLIARD CORP., THE ..... *
Agency—Mellor Advertising Agency, Inc.
HUYETTE CO., INC., PAUL S. ..... *

ILLINOIS WATER TREATMENT CO. 128
Agency—Cummings, Brand & McPherson
INFILCO, INC. 58
Agency—Willard G. Gregory & Co.
INSTROF, INC. 120
Agency—R. E. Lovekin Corp.
INTERNATIONAL NICKEL COMPANY, INC., THE ... 107
Agency—Marschalk & Pratt Co. Division of McCann-Erickson, Inc.

JOHNS-MANVILLE 109
Agency—J. Walter Thompson Company
JOHNSON-MARCH CORP. ..... *
Agency—Beaumont, Heller & Sperling, Inc.

KIRK & BLUM MFG. CO. 121
Agency—The S. C. Baer Co.
KOR CORPORATION ..... *

LADISH CO. ..... *
Agency—The Cramer-Krasselt Co.
LESLIE CO. ..... *
Agency—Reid, Decker & Stockl, Inc.

MADDEN CORP., THE 131
Agency—Kreicker & Meloan, Inc.
MANNING, MAXWELL & MOORE, INC. 40, 103
Agency—Fuller & Smith & Ross, Inc.
MERIAM INSTRUMENT CO., THE ..... *
Agency—Thomas R. Sundheim
MILTON ROY CO. 111
Agency—The Aitken-Kynett Co.
MUNDET CORK CORP., INSULATION DIV. 112
Agency—J. C. Burl, Inc.

NAGLE PUMPS, INC. ..... *
Agency—Tri-State Advertising Co., Inc.
NATIONAL AIROIL BURNER COMPANY, INC. ..... *
Agency—R. E. Lovekin Corp.
NATIONAL ALUMINATE CORPORATION 34
Agency—Armstrong Advertising Agency
NATIONAL VALVE & MFG. CO. ..... *
Agency—Bond & Starr, Inc.

NEW ENGLAND CARBIDE TOOL CO. ..... *
Agency—Callaway Associates
NIAGARA BLOWER COMPANY ..... *
Agency—The Moss-Chase Company

OHIO INJECTOR CO. ..... Inside Front Cover
Agency—Fuller & Smith & Ross, Inc.
ORR & SEMBOWER, INC. 19
Agency—Beaumont, Heller & Sperling, Inc.

PACIFIC PUMPS, INC. 10–11
Agency—The McCarty Co.
PEABODY ENGR. CORP. 130
Agency—Richard LaFond Adv. Inc.
PEERLESS PUMPS DIV. FOOD MACHINERY & CHEMICAL CORP. 119
Agency—The McCarty Co.
PERMUTIT CO., THE ..... *
Agency—Cunningham & Walsh, Inc.
PHILADELPHIA PUMP & MACHINERY CO. 22–23
Agency—The Michener Co.
H. A. PHILIPS 128
Agency—Glenn-Jordan-Stoetzel, Inc.
PITTSBURGH PIPING & EQUIPMENT CO. ..... *
Agency—W. S. Hill Co.
POWELL VALVES 21
Agency—The Ralph H. Jones Co.
PREFERRED UTILITIES MFG. CORP. ..... *
Agency—Spooner & Kriegel

QUAKER RUBBER CORP. DIVISION OF H. K. PORTER CO., INC. OF PITTSBURGH 56
Agency—Fox & MacKenzie Advertising

RANNEY METHOD WATER SUPPLIES, INC. 127
Agency—Cye Landy Advertising Agency, Inc.
RAYBESTOS-MANHATTAN, INC. ..... *
Agency—Gray & Rogers
REFRACTORY & INSULATION CORP. 30
Agency—Spooner & Kriegel
RELIANCE GAUGE COLUMN COMPANY 48
Agency—Carr Liggett Advertising, Inc.
REPUBLIC FLOW METERS CO. 38–39
Agency—Glenn, Jordan, Stoetzel, Inc.
REVERE COPPER AND BRASS, INC. 59
Agency—St. Georges & Keys, Inc.
RIC-WIL INC. 18
Agency—Ritchie & Sattler, Inc.
RILEY STOKER CORPORATION ..... *
Agency—The Davis Press, Inc.
ROTO DIV. OF ELLIOTT CO. 28
Agency—Jos. S. Vogel & Co.
R-P & C VALVE DIVISION, AMERICAN CHAIN & CABLE CO., INC. 124
Agency—Reincke, Meyer & Finn, Inc.

SANTA FE TANK & TOWER CO. ..... *
Agency—Advertisers Production Agency
SARCO COMPANY, INC. ..... *
Agency—Marsteller, Rickard, Gebhart & Reed, Inc.
SCHUTTE & KOERTING CO. ..... *
Agency—Harris D. McKinney, Inc.
SCOVILL MFG. CO. ..... *
Agency—Robotham & Peck, Inc.
SINCLAIR REFINING CO. 1
Agency—Morey, Humm & Johnstone, Inc.
SOUTHERN COAL CO., INC. 123
Agency—Hitchcock & Becker Advertising
STANDARD OIL CO. (INDIANA) 29
Agency—D'Arcy Advertising Co.
STEPHENS-ADAMSON MFG. CO. 115
Agency—Glenn-Jordan-Stoetzel, Inc.
STONE & WEBSTER ENGINEERING CORP. 55
Agency—Harold Cabot & Co., Inc.
SUPERIOR COMBUSTION INDUSTRIES, INC. 116
Agency—Charles H. Davis

TAYLOR & CO., W. A. ..... *
Agency—Emery Advertising Corporation
THE TERRY STEAM TURBINE CO. 54
Agency—Gassaway Advertising Agency
TEXAS CO., THE ..... Back Cover
Agency—Erwin, Wasey & Company, Inc.

UNION ASBESTOS & RUBBER CO. 106
Agency—The Buchen Co.
U. S. ELECTRICAL MOTORS, INC. ..... *
Agency—The McCarty Co.
UNIVERSAL ATLAS CEMENT CO. ..... *
Agency—Batten, Barton, Durstine & Osborn, Inc.

VOGT MACHINE CO., HENRY 122
Agency—Farson, Huff & Northlich

WALLACE & TIERNAN PRODUCTS, INC. ..... *
Agency—Brar state Associates, Inc.
WATSON-STILLMAN CO. 113
Agency—W. L. Towne Advertising
WESTERN CHEMICAL COMPANY 125
Agency—Carter Advertising Agency, Inc.
WILSON, INC., THOMAS C. 127
Agency—Michel-Cather, Inc.
WORTHINGTON CORPORATION ..... *
Agency—James Thomas Chirurg Company

YARNALL-WARING COMPANY 8–9, 60
Agency—The Michener Co.

Firms whose advertising is not in this issue but is appearing in other issues is marked with an *

DE LAVAL OPPELLER PUMPS

last longer... cut maintenance costs

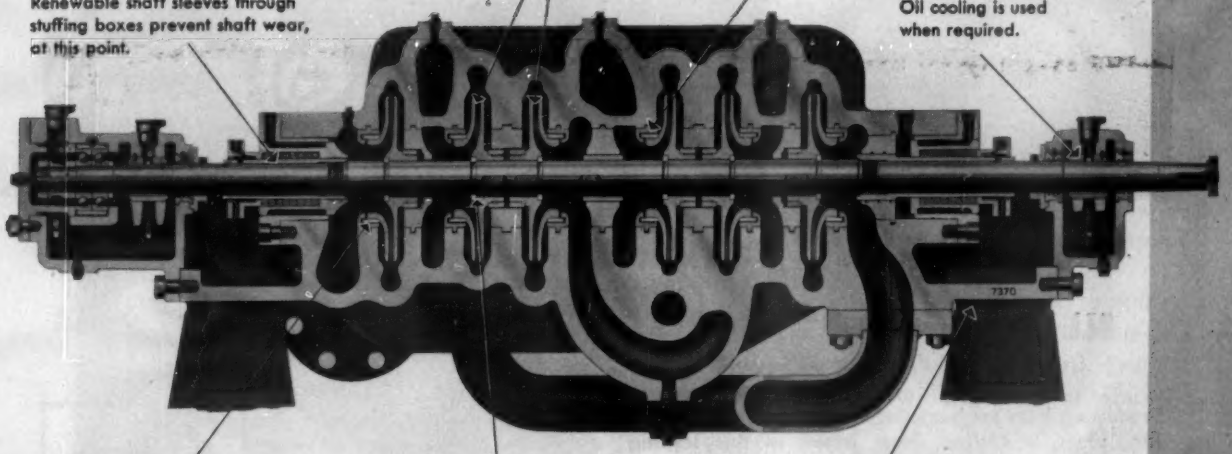
Stages are arranged to reduce differential pressures between stages. This insures permanent sealing at the casing-joint and at interstage diaphragms.

Pairs of back-to-back impellers balance axial thrust. One-purpose thrust bearing carries no radial load, maintains axial alignment.

Labyrinth wearing rings permit safe clearances and reduce wear.

All bearings are ring-oiled, sealed against contamination by water or dust. Oil cooling is used when required.

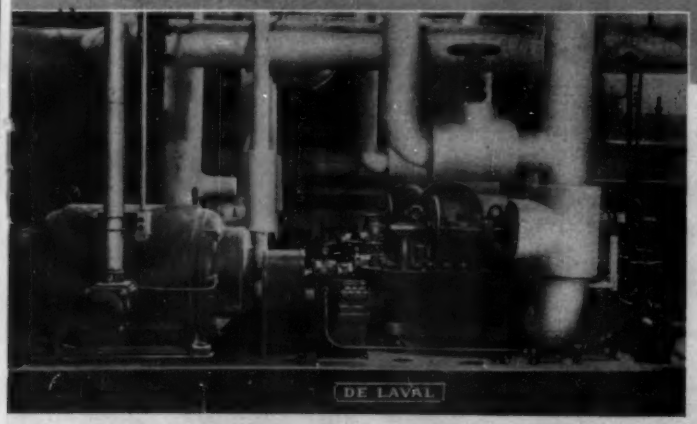
Renewable shaft sleeves through stuffing boxes prevent shaft wear, at this point.



Threaded impeller wearing rings make replacement easy without heating or damage to impellers.

Individual impeller mountings, with split locating rings, make interstage shaft sleeves unnecessary. Impellers can't shift with shaft expansion and contraction.

Casing support insures coupling alignment at any operating temperature.



Here are two De Laval 6-stage Oppeller Pumps used for boiler feed service in an industrial installation.

The design features above show clearly why De Laval Oppeller Pumps stay on the line longer and cost less to maintain. These pumps are used for boiler feed, hydraulic systems, descaling spray, mine dewatering, refinery oil pumping and similar services.

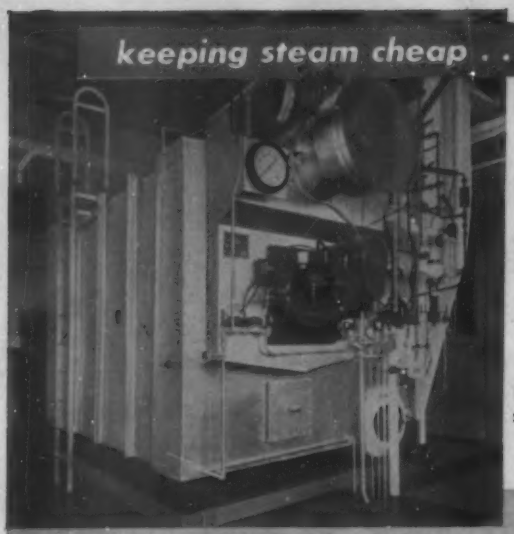
De Laval Oppeller Pumps are available in sizes from 2 to 4 inches and 2 to 8 stages; capacities to 1000 gpm, pressures to 1200 psig and temperatures to 3500F. *For complete data, write for De Laval Catalog 1502.*

DE LAVAL *Oppeller Pumps*

DE LAVAL STEAM TURBINE COMPANY

816 Nottingham Way, Trenton 2, New Jersey

DL284



B&W Integral-Furnace, Type FM Unit which supplies steam for all plant purposes.

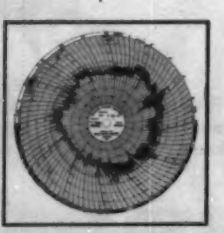
Main plant building of Shulton, Inc.

Engineers: Emil Gruenberg & Associates, N. Y. C.
Architects: Drake, Tuthill, Convery & Cueman Associates Summit, N. J.

B&W FM Boiler Supplies NEW STEAM FOR *Old Spice*

Production lines are humming at the beautiful Shulton, Inc., plant in Clifton, New Jersey, as this leading toiletries manufacturer hustles to keep pace with the huge and growing demand for its *Old Spice* and other lines of popular products. Started from scratch less than 20 years ago, Shulton, Inc., now makes its own dies, boxes, packages, and plastic closures for the toiletries which today sell in 28 countries and the United States.

Production on this scale requires a reliable source of economical steam for heating, hot water, and processing operations in the plant's chemical and packaging divisions. When maintenance costs on the two original boilers at the plant began to rise, a B&W FM Unit to provide 15,000 lb of steam per hr at a pressure of 150 psi was installed and went into service last February. The unit burns up to 1600 gallons of #5 oil in 24 hrs., depending upon load. With a return as high as 75%, makeup water required runs between 25 and 50%. Mr. N. J. Fowler, Plant Engineer in charge of Shulton's Clifton operation, declared that "the FM handles wide load swings extremely well and everyone concerned is very happy with the new boiler."



Like *Old Spice*, B&W FM Boilers are quality products. They have earned a reputation for efficient, economical steam generation for power, processing, and heating in a broad range of industrial, commercial, and institutional applications. Available in standard sizes with individual capacities to 40,000 lb of steam per hr and pressures to 235 psi, many FMs are in service at higher pressures and with moderate superheat. Note the list of cost-saving features typical of this versatile unit.

Write for the detailed description of the FM in Bulletin G-76. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

G-729

COST-SAVING FEATURES

- Saves Erection Time and Cost
- Meets Wide Range of Service
- Handles Quick Load Changes
- Suitable for Outdoor Service
- Safe, Automatic Operation
- Fast Steaming
- Low Maintenance
- Easy Accessibility
- Burns Oil and/or Gas
- Saves Fuel
- Saves Space

BABCOCK & WILCOX BOILER DIVISION

For more data circle 578 on Post Card

Chapman List 960

...for EVERY Small Forged Steel Gate Valve Application

Month after month, Chapman List 960 Valves deliver the goods on more different jobs than any other small forged steel gate valves. And maintenance charges are few and far between even under the toughest conditions.

The wedge gate faces — hardened to 800 Brinell by Chapman's exclusive Malcomizing process — won't seize or gall. Seat rings are hardened stainless steel, for minimum wear, and are easy to replace. Also, the bolted follower has no exposed threads on the yoke to corrode.

For every small forged steel gate valve application, specify Chapman List 960. Sizes from ¼" to 2", either rising stem with yoke (shown) or rising stem with inside screw. Bonnet joint is ground metal-to-metal or gasketed, depending on application. Pressure range is from 380 psi at 1000°F to 2000 psi at 100°F. For higher ratings, specify List 990.

List 960 is made in various alloys and combinations of alloys as listed in Catalog No. 10. Write for your copy today.

The CHAPMAN Valve
Manufacturing Company
INDIAN ORCHARD, MASSACHUSETTS

For more data circle 579 on Post Card